SHOUT
SHARE
IT

THE LIBRARY
SMITHSONIAN INSTITUTION

SMITHSONIAN INSTITUTION THE LIBRARY

RANDOM RECORDS OF A LIFETIME,
DEVOTED TO SCIENCE AND ART, 1846-1931

BY W.illiam H.enry HOLMES

VOLUME III

SURVEY OF THE YELLOWSTONE PARK IN TWO PARTS

PART I, 1872, AS ARTIST TO THE SURVEY
OF THE TERRITORIES.

PART II, 1878, AS GEOLOGIST, ASSISTANT
TO DR. F. V. HAYDEN, DIRECTOR

CT
275
H75A
v. 3
RB
NCFA

RANDOM RECORDS OF A LIFETIME
DEVOTED TO SCIENCE AND ART, 1846-1931.

VOLUME III

SURVEY OF THE YELLOWSTONE, PART I, 1872

W. H. HOLMES ARTIST TO THE SURVEY.

Portrait of Doctor Hayden. and Ms [illegible] by [illegible] 32113 - G

Narrative of Trip West.

Visit to Salt Lake City. (June 4, 1872)

Camp at Ogden.

Mountain Climbing in Vicinity of Ogden.

Stage Trip to Fort Ellis, Montana.

Hunting and Sketching about Camp.

Story of the Water Ouzel.

Death and Burial of Mrs. Blackmore.

Sir William and Lady Blackmore were guests of the Survey.

Yellowstone River, Canyon and Falls.

Hot Springs and Geysers.

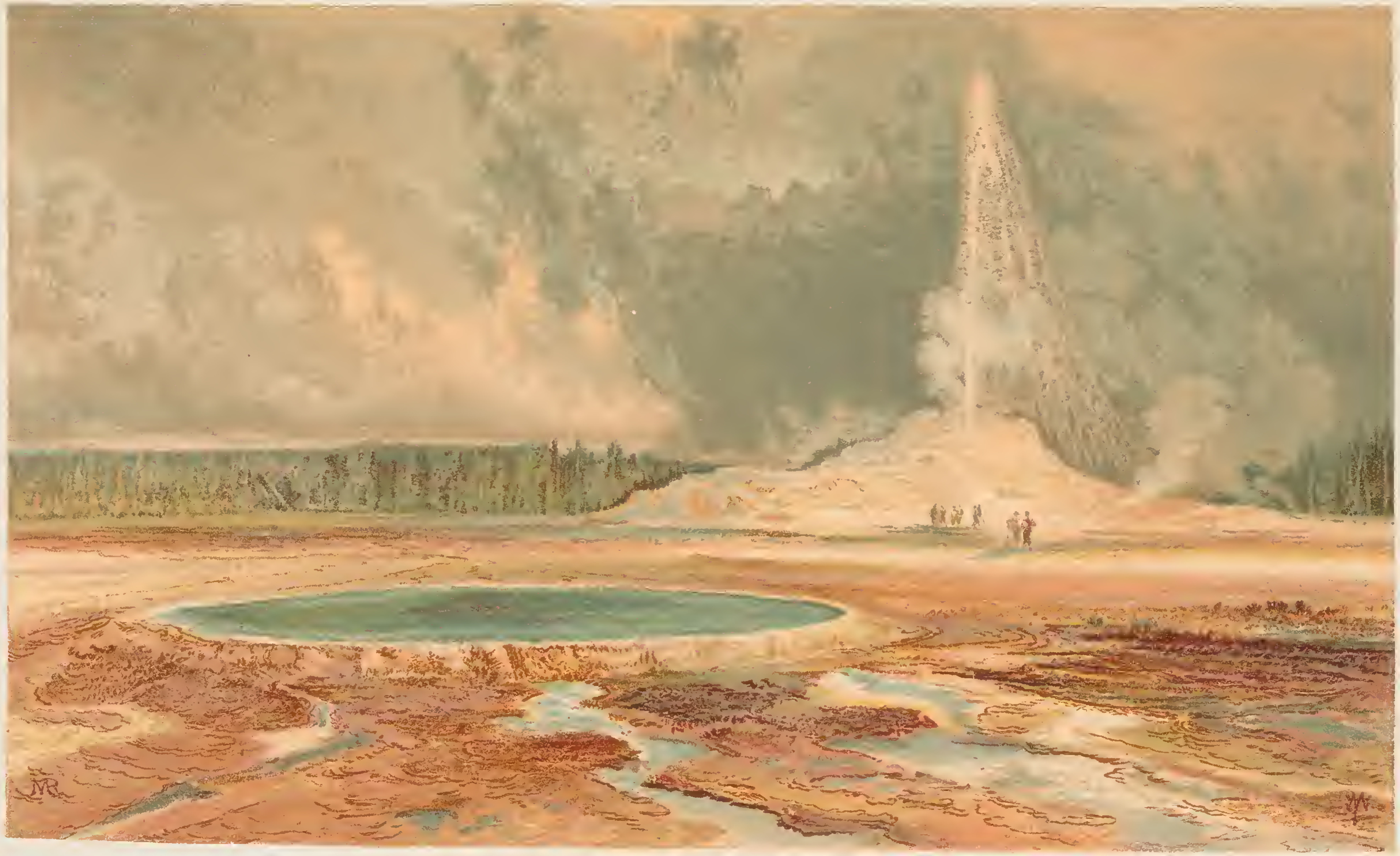
Upper and Lower Geyser Basins.

No End of Marvels.

Naming of the Great Fountain Geyser.

Trip on East Fork of the Yellowstone.

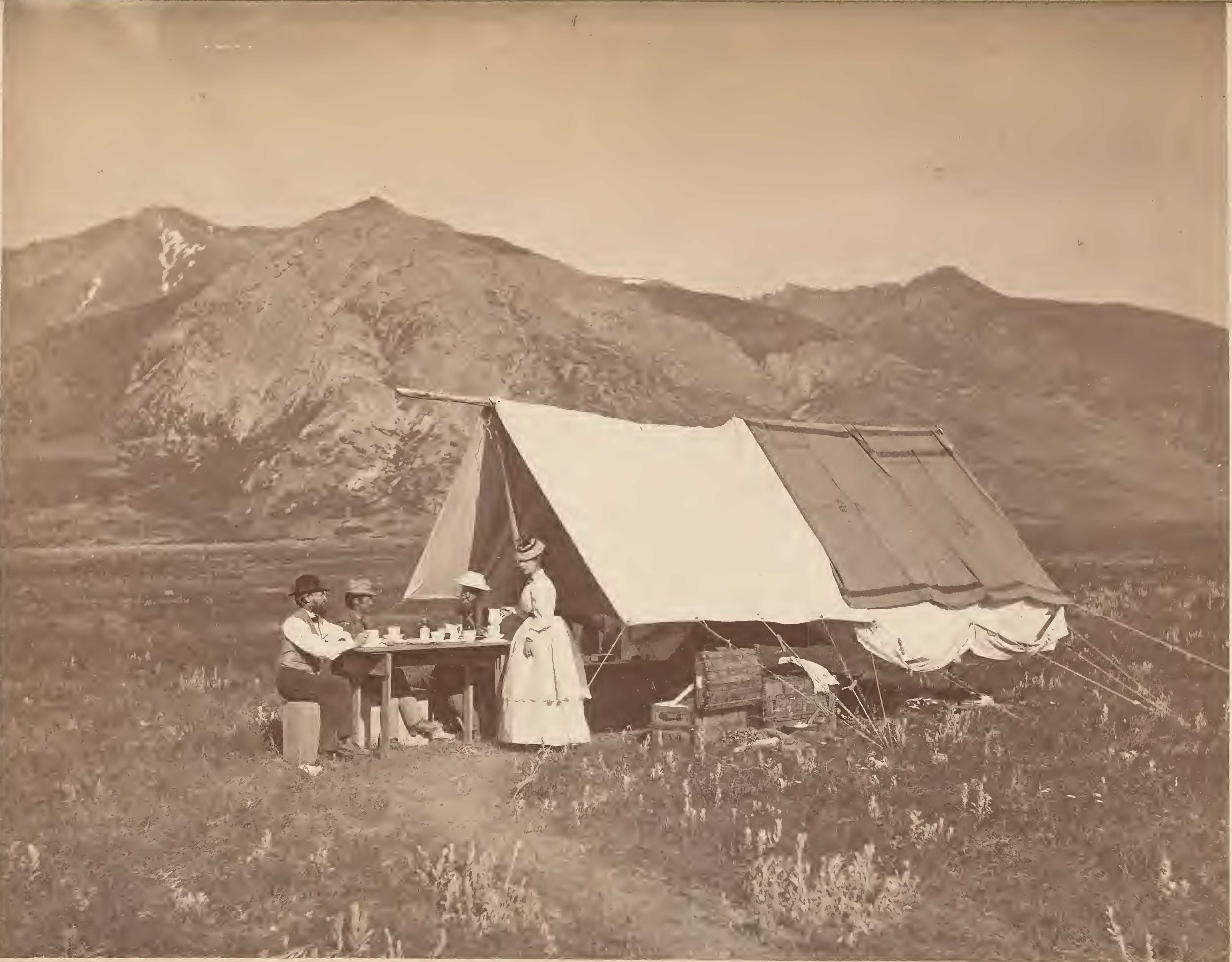
Return to Ogden and Washington.



T. MORAN

Frontispiece, 5th report,
Moran's painting in water colors
printed [illegible],
lithographed by Prang Co.

Dr. and Mrs Hayden, Stevenson and Bradley in Camp 1878.



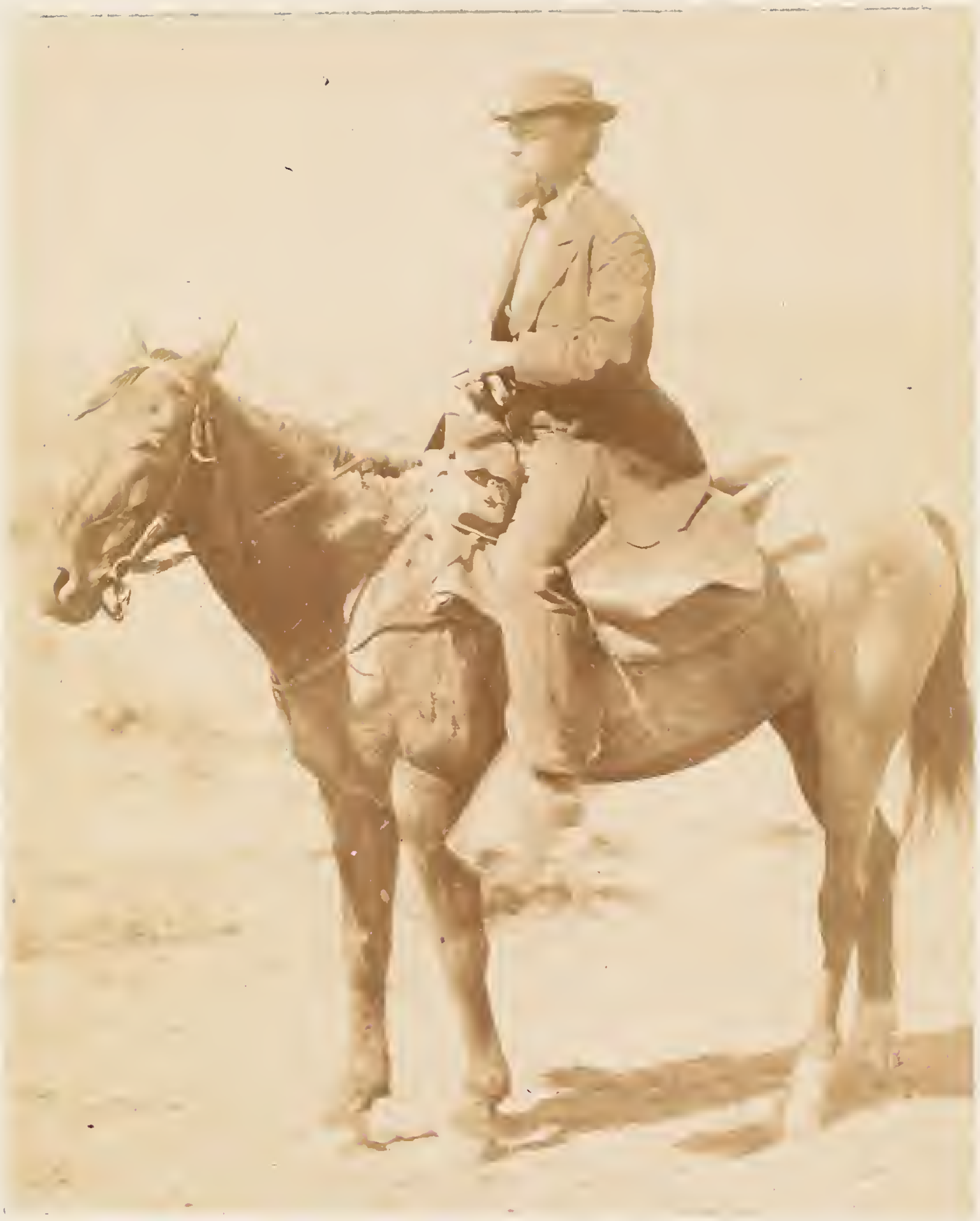
C. R. SAVAGE, PHOTO. Dr. and Mrs Hayden, Stevenson and Bradley in camp SALT LAKE CITY.

Museum Reg. No. 42113-6

Q. When were the wonders of Yellowstone National Park first known to the world?—H. T.

A. The Yellowstone region was originally occupied by peaceful Sheepeater Indians. There are evidences that white trappers had entered the region as early as 1808, but the rumors of its wonders which from time to time reached the civilized world were given little credence until Henry D. Washburn, surveyor general of Montana, published the first real account of it in 1870. In 1871 the region was explored and mapped by the United States Geological and Geographical Survey of the Territories, and in 1872 Congress made it a national park.

[illegible] My first [illegible]



Dr F. V. Hayden, Director of the Survey of
the Territories. 1871 WHJ

YELLOWSTONE EXPEDITION, 1872

W. H. Holmes, Artist to the Survey of the Territories

During the winter and spring I had been engaged in drawing for several of the Smithsonian scientists and in May received my appointment as artist to the U. S. Geological and Geographical Survey of the Territories, salary $1800. I had packed everything in my valise--a slim outfit of clothes and a supply of needles, thread, pins, pencils, paper, paints, etc., and bade goodbye to Professor Meek and the rest on Wednesday evening, May 29. Together with Carrington, Logan and Kiser, I left Dr. Hayden's office on the corner of 11th Street and Pennsylvania Avenue (later the Evening Star building). Having my tickets to purchase I started down the Avenue on foot, employed a negro to carry my valise and reached the depot at 7:30. Mr. Leonidas Hunt an old school mate was there to bid me adieu. Took sleeping car. Crossed ~~to~~ the summit of the Alleghanies at sunrise, a dull, rainy morning, thirtieth of May, Decoration Day. Left Pittsburgh at about ten o'clock, and passing through central Ohio and Indiana, reached Chicago about 7:00 on Friday morning. Spent a few hours seeing this wonderful city, now rising from its ashes. It seems quite possible to see it growing. Took supper in the dining car and passed through Burlington, Iowa. Reached the Missouri at 10:00 A. M. Saturday, and in Omaha we met Taggart, West and Jaycox. Stopped until 11:00 A. M. Sunday at the Wyoming House and completed our outfits at the firm of Wilcox and Company. As we passed

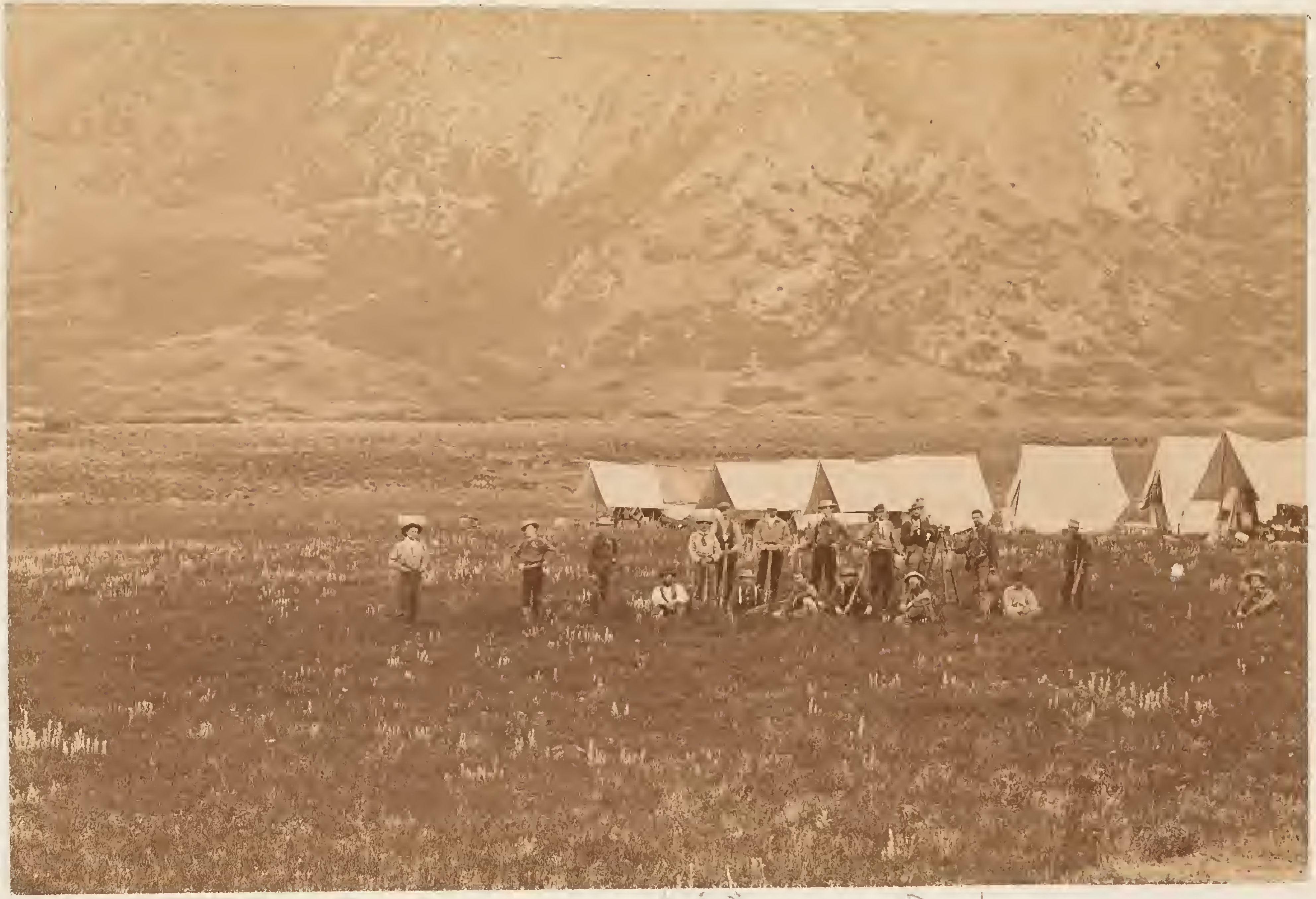
up the Platte the plains began to spread out and were very fertile in appearance. Villages of prairie dogs became frequent and antelopes were occasionally seen. On Monday the country became barren looking, the towns on the plains having a sickly, uninviting look. At Sidney we stopped for a while and I gathered many new varieties of flowers and helped to kill a rattlesnake. Got supper at Cheyenne on Monday evening and reached the summit of the first range of mountains at Sherman by sunset. Cool showers were sweeping across the range and a superb rainbow was seen. The effect on the mountains to the west was novel to me and exceedingly splendid. On Tuesday we passed through hundreds of miles of the most desolate country I have ever seen -- plains bare or covered with sage, and here and there barren rocks and castellated cliffs varying the monotony. Occasionally a creek of bitter, muddy water wound through its deep and dreary channel. The bones of many cattle were seen and we wonder that either man or beast should have succeeded in crossing such a desert.

The valley of the Green River and its canyon afforded many curious and interesting scenes, the scenery in Weber Canyon as we approached Salt Lake defying description. We reached Ogden at about 7:00 o'clock on Tuesday evening, June 4, having been on the cars almost every hour for five days. I was scarcely more tired than when I left Washington six days before. At the depot we met Stevenson, Administrative Assistant, and took supper at the Ogden House, after which most of

our party walked out about a mile toward the mountain. In the morning, Wednesday, I went out to camp where I found Stevenson, Savage, Bradley, Herring, Logan, Carrington, Jones, Nicholsen, Campbell, Merriam, Jaycox, West, Taggart, Negley, Eastlake, Bechler, Keyser, Coulter and a number of camp men, packers, etc. (See photograph) The camp consisted of six tents and three or four covered wagons.

I took up my abode in the tent next that of Stevenson, but in the evening went off with West and Taggart for a rail trip to Salt Lake City. It took us about an hour and a half from Ogden to Salt Lake. The valley seems fertile but can not be cultivated without irrigation. The lake was quiet all the way and the sunset made many fine effects among the mountains and islands. The size and beauty of the city of Salt Lake surprised us. We hastened to the Salt Lake House, registered, engaged rooms and hastened to the theater where we heard the Zavatowski sisters in "Cinderella" and a drama.

In the morning we visited the Presbyterian minister Rev. Sheldon Jackson and afterward the Mormon Tabernacle which is the most curious specimen of architecture that can be imagined. We were shown through it by the janitor. The organ is immense and the seating capacity of the hall is said to be 13,000. From the roof we obtained a very fine view of the city and the snow-capped ranges that surrounded the valley. Descending we passed by the great Temple which is to be, the foundation walls being in place, -- the result of twenty years


Logan
Savage
[illegible]
Holmes
Joyce
Bradley
Beckler

Field party in camp near Ogden Utah, 1872
getting ready for the start to the Yellowstone

Standing

Sitting

Savage 1

Merriam 2 Logan

Holmes 3

Joycox 4

Bradley 5

6

7 J. Platt

8

9 Herring

10 Bechler

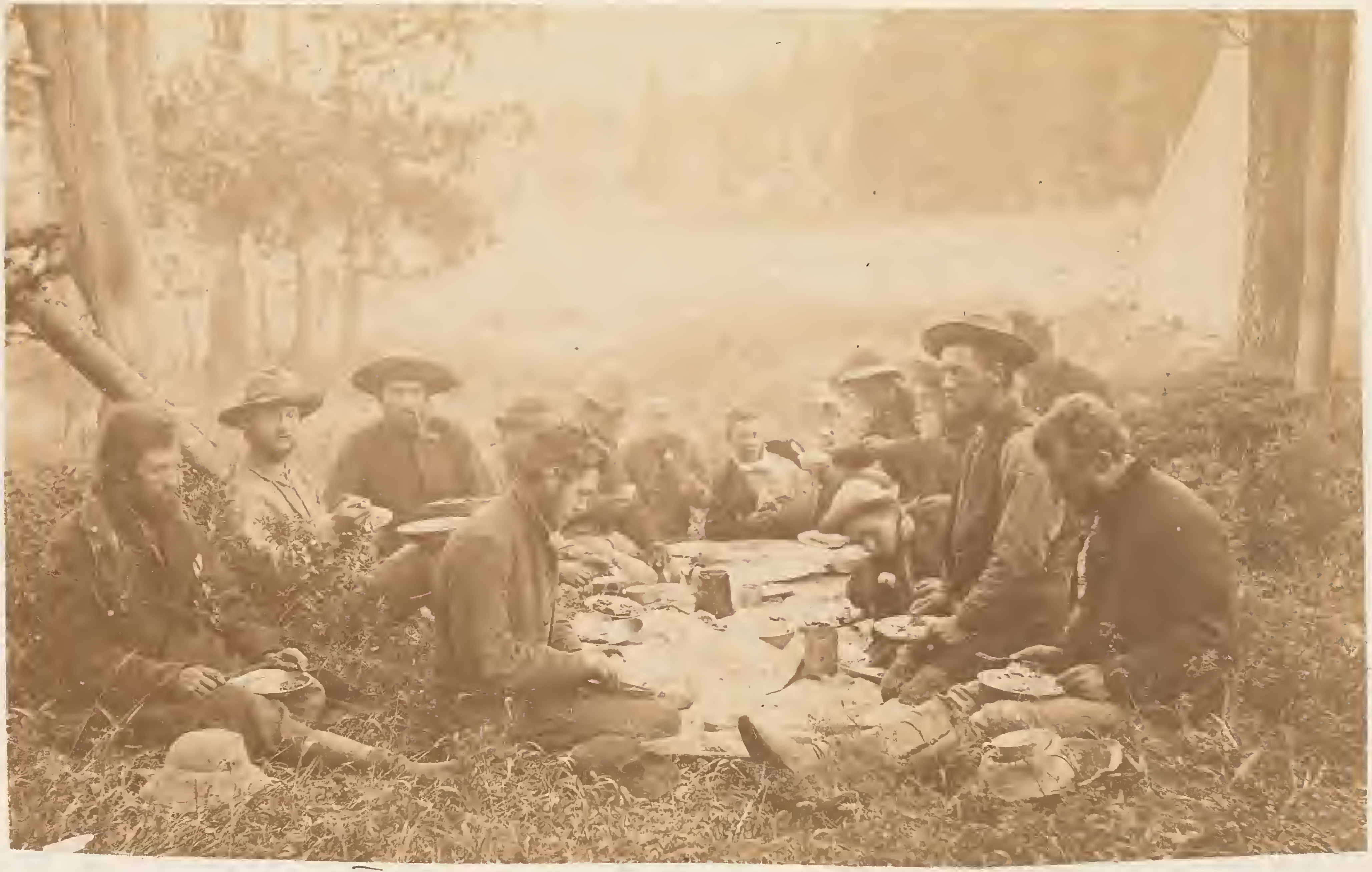
11

work. We passed up a stream to the two residences of Brigham Young and his thirty-five wives, but saw nothing of the inmates. Afterward we drove to the depot and returned to Ogden.

Thursday night was my first in camp. Did not sleep very well but think I shall like the manner of living. We have two meals per day, and for want of chairs stand by the board to eat out of tin pans. On Friday morning I took my sketching materials and with three companions started for the mountains. A mile or so brought us to the base and after an hour's climb to the falls, a beautiful cascade formed by a little stream that leaps over the steep wall into a deep canyon at a visible height of about 200 feet. I made sketches with young Jones at my side and killed a rattlesnake with five rattles. Returned to camp.

Saturday strolled out by myself toward Ogden Canyon. Met and killed a large rattlesnake on the upper terrace of the mountain. Passed up a mile into the mountain expecting to come down into the canyon, but found myself going up and up thousands of feet above the river, and as it was a long way back I decided to descend by a slide of loose material in a steep narrow rock walled gorge. As I could not see far down the slide, I loosened a few rocks and tumbled them in. Down they rushed, leaping ten, twenty, fifty feet at a bound, sending up echoes from far below. I made this descent, however, without much difficulty, climbing down and around the steep cliffs and sliding and stumbling down the streams of debris.

Reunion Camp Lower Geyser basin



Survey of the Territories 1872

West, Carrington Negley Jackson Holmes

Jaycox Taggart Beveridge

Museum Reg. No. 3213 a.

At the bottom I found the road about twelve feet wide fairly blocked up by the boulders that had come down with the few I started from the top. The swift and turbulent stream is so close as to leave but little room for the road, the canyon being narrow and the walls almost vertical for hundreds of feet. Found numbers of men and boys fishing for trout. Made some sketches up and down the canyon. Found a short cut path and returned to camp.

Sunday, the 9th of June, I spent in sketching and during the week following made several excursions sketching, gunning and geologizing. The most notable event was the ascent of the snow-capped mountain, the highest of the Wasatch range in this region. With Jackson and others I left camp at about 12 o'clock, the main object being to get some photographs of the falls, the view of which is very fine from the high rocky ledge on the south. A rainbow played about its base and thousands of white wiry streams of water played fantastically among the chinks of the broken wall.

Jackson remained below preparing his camera and I was soon well out of sight up the succession of high cliffs above the falls and finding myself considerably advanced toward the summit of the mountain I decided to follow up the ledge and ascend the snowy summit. About a mile of exceedingly hard scrambling through dense copses of bushes and great piles of rocks brought me to the first snow. Being thirsty I gathered a few handfulls and placed it on a rock, allowed it to melt

in the sun, when I drank it. Many species of flowers were blooming along the snow margins among which were thousands of "spring beauties," different from our eastern species only in having a much broader leaf. I found myself becoming somewhat tired, but a mile of the hardest part of my journey was before me and I moved on. It would not do to stop long for it was already 5 o'clock.

Picked up many fine specimens of minerals but could take only a few with me. Reached the top of the highest peak at 6 o'clock. The plains and the lake had risen like a wall as I ascended and I now had a fine view of the whole Salt Lake valley with the well defined islands and the great mountain ranges. Ogden lay at my feet and our camp was hardly visible in the distance. I stood on a ridge but a few feet wide which was notched like saw teeth and extended at almost the same elevation for a quarter of a mile or more to the northwest. Some ambitious predecessor had built two considerable piles of stones on the very summit to celebrate his triumph. I proceeded to indulge in the favorite mountain amusement of pitching them stone after stone down the steep and far reaching declivities, and watching them until they were lost to sight among the canyons or buried in the snow.

The point where I stood is 10,000 feet above the sea level and just one vertical mile above our camp and perhaps four miles from camp horizontally to the north.

Lest night should catch me before I could get out of

the mountains I began the descent and a short scramble soon brought me again to a clear snow descent, and I slid with increasing rapidity downward. This was highly encouraging and as I moved down I enjoyed myself watching the fine effects of sunset on the mountain tops. Glancing downward before me I was taken very suddenly aback by catching sight of a dark opening in the snow but a few yards ahead of me and directly in my course. I saved myself only from a very unwilling exploration of the region below by whirling suddenly over and driving my fingers and toes with all possible force into the snow. After this I proceeded with more caution, but soon reached the lower edge of the snow. Just at dark I found an old miner's mule path and at 9:00 o'clock reached the level plain. In less than an hour I was in camp. Two of the boys, Taggart and Merriam, were out on the hunt for me, thinking it possible that I had met with some accident. They came in soon, however, for refreshments and found us all at supper which meal I was hungry enough to enjoy, it having been fifteen hours since breakfast, ten of which were spent in hard work. On the same day Professor Bradley had ridden into a canyon and in making geological examinations had tied his horse to a tree and on returning found the animal down and strangled to death.

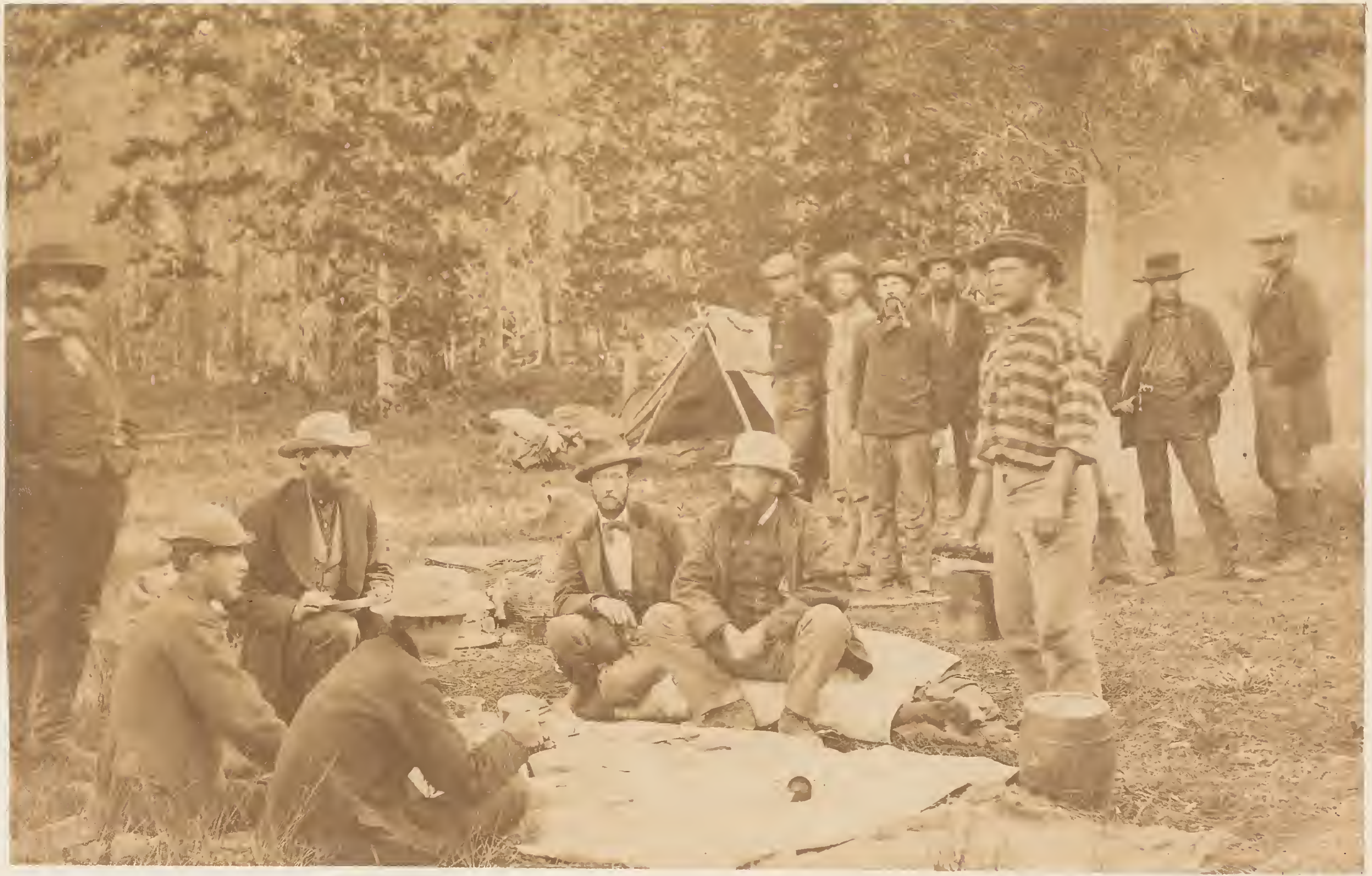
I remained in camp most of the next day, Friday, although not as tired as I expected to be. In the evening Professor Hayden, his wife, and a few others - Grevy, Adams, Brown, Beveridge and Platt came into camp. On Saturday I went out with

Peale, Savage, Platt and Beveridge on horseback to examine the mountain lying to the north of camp beyond the Ogden River. Made sketches and returned to camp by 5:00 o'clock in the afternoon. At 6:00 Jackson took a photograph of the camp with most of the boys in the foreground and the mountains showing splendidly in the background.

Stage Trip from Ogden, Utah to Fort Ellis, Montana.

On June 22nd Dr. Hayden gave sudden orders to nine of us to get ready for immediate departure from the Ogden camp for Fort Ellis, Montana - Peale, Burck, Logan, Platt, Savage, Hovey, Raymond, Greve and myself. Mr. Herring came with us to Fort Hall. We took passage by stage coach at 5 o'clock for Corinne, where we stopped until morning at the principal hotel of the place. The town is pleasantly situated and has some good stores and perhaps 500 to 800 inhabitants. At six in the morning we - ten of us - with our great bundle of baggage took stage for Bozeman, a distance of 480 miles. I took the outside and although the air was cool the time passed very pleasantly as the scenery was fine and the character of the country strange to me. We passed up the valley of the Malad, a small alkaline basin with a small river which runs west into Bear River. We were still in the region of Mormon settlements and the stage road was frequently cut up by irrigation ditches, many of which were difficult to cross, and the Driver amused

The Hayden Survey party in the Yellowstone country 1872



Dr. Coulter, (Botanist), Dr. Hayden, (Director) Mr. [illegible] (Expert [illegible])

Mr. Blackmore, (English gentleman)

Rush Taggart

Henry Gannett (Topog.)

Mr. Hamp (young Englishman)

a packer

Mr. West

Joseph Savage

Campbell Carrington

Riley.

Jim Payne (cook)

himself by jeering the inhabitants in the most choice of the stage driver's vocabulary, punctuated with unmentionable oaths.

In the middle of the day it was hot and dusty and I got inside. The dense tobacco smoke made me awfully sick and I again got outside. Horses were changed about every twelve miles.

The first day took us about 60 miles, driving four horses the whole time. We took dinner at a station and at its conclusion a new driver with six fine horses was waiting to carry us over the first "divide." I never saw such driving or so intensely enjoyed a ride. Rushing with the utmost precision through narrow and crooked places over bridges and among rocks, we felt perfectly safe for the art of that man was as sure as science. We entered Marsh Valley toward evening and during the night passed through Port Neuf. Mr. Herring got out at daybreak for the purpose of going to Fort Hall where Ganett and Wakefield were stationed. In the forenoon we crossed the Snake River by Taylor's bridge. Passing through a narrow and rocky gorge the current is very swift.

(From Taylor's bridge no notes were made of the drive to Fort Ellis near Bozeman, Montana, a trip of four days and nights.)

IN CAMP NEAR BOZEMAN, MONTANA.

Of course it was annoying to be kept indoors, instead of being on excursions among the mountains as we had expected, but we read our papers over a second time and then borrowed of our neighbors. About half of the boys had managed to get off to town, Bozeman, where they are now luxuriating at a hotel. It is now past noon on Monday and the rain is again steadily falling. As yet we have no fires, if it turns cold we will yet have rather a sorry time as everything is so very wet.

We have six tents erected thus: (see photo)

Dr. Peale and I haunt the tent in the foreground, where as we lie snugly in bed, we can hear the constant patter of the rain and snow and the really sweet music of the gurgling stream, which passes but a few feet from our heads. From camp we can see no indication of Cintralion but a patch of ground cultivated by the soldiers of the fort. At the Post - which is a collection of log and frame buildings, with block house and theatre of slabs, etc. - are four companies of troops. Desertions are said to occur very frequently, and judging by the number of "boys in blue", who were at hard labor under guard, some of the aspirants for freedom had been caught.

After continuing three nights, and two days and a half the snow and rain ceased and things began to come into shape. Tuesday, July 2nd, we took our meals in Camp, breakfast at twelve, supper at six. In the afternoon we got things dried out a little, and I with young Bennett of the P.N. garden took a tramp over the foot hills to the North of Camp. Flowers

grow most profusely on the bluff tops. Sitting on one ridge I counted fourteen species of most beautiful flowers all blooming within twenty feet of me

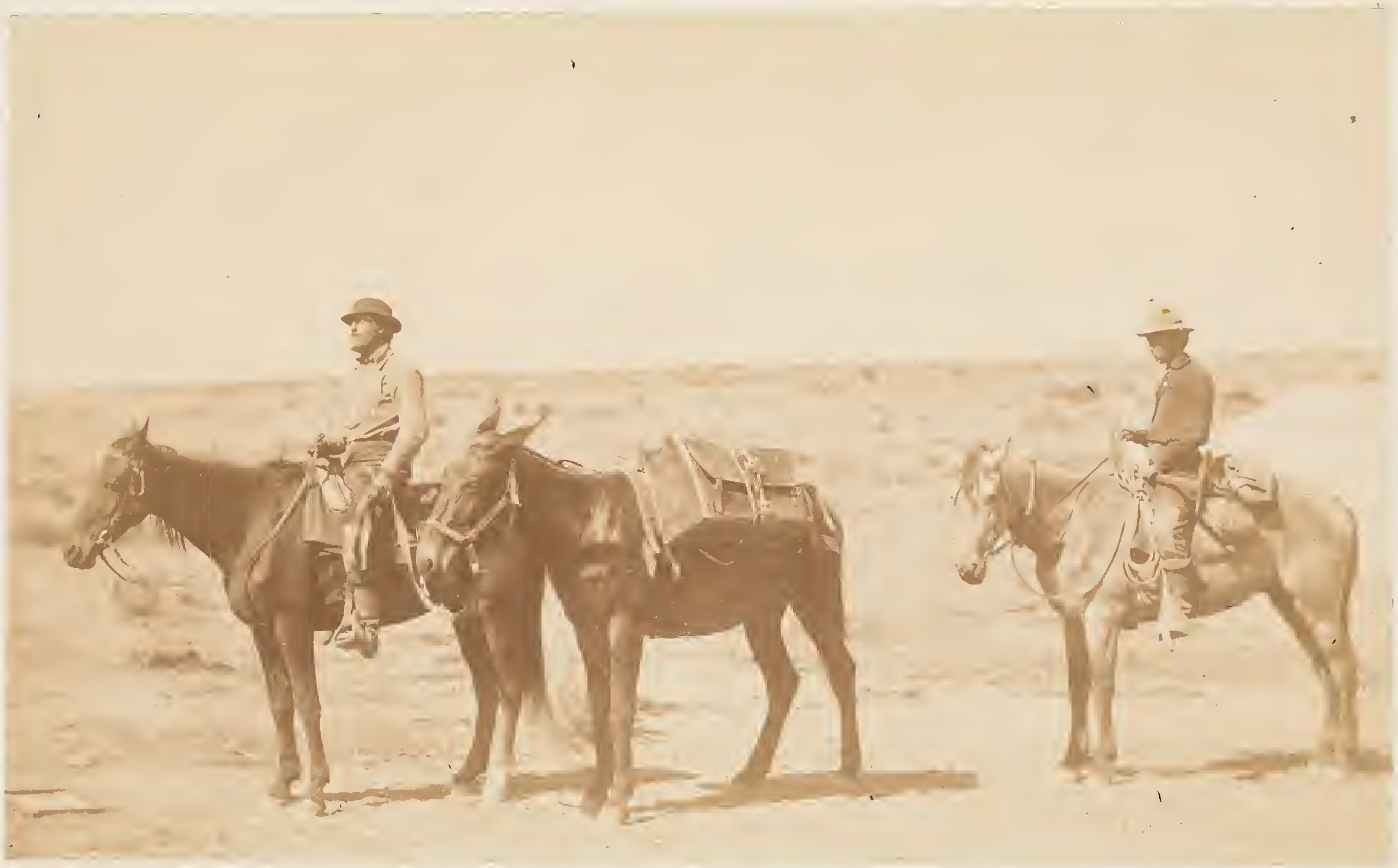
On Wednesday, Dr. Peale and I took a walk across the hills to Spring Canon which enters the mountains about three miles east of camp.

July Fourth, The Glorious Yankee Doodle Day was hardly recognizable. Stayed in Camp most of the day. The cannon at the fort were fired at 11 o'clock and again at sunset. I made sketches in color of Jno Raymond, Mr. Savage and Dr.Peale.

Early on Friday morning I started with Bennet to the Mountains east of Bridger Peak for a days hunt. We had a carbine and a long betsy of a shot gun and three loads of powder and shot - excepting the powder which was left at the shanty. The mountains were fairly covered with deer, bear and elk tracks and we saw a number of sage hens. He shot at an elk and an antelope but missed both. I fired at a sage cock with my one load but did no harm to anything. We came home gameless, after a twenty mile tramp over the roughest of country. Doctor Hayden had arrived during our absence and the work of organizing for the trip into the Yellowstone had already commenced.

Next day I made a sketch of the Valley and Post - from a bluff half a mile Northwest and spent the evening cleaning and greasing my saddle and going to the Hospital with Peale.

The seventh was Sunday, but I did not think of it until



With Jackson photographer starting out Dixon

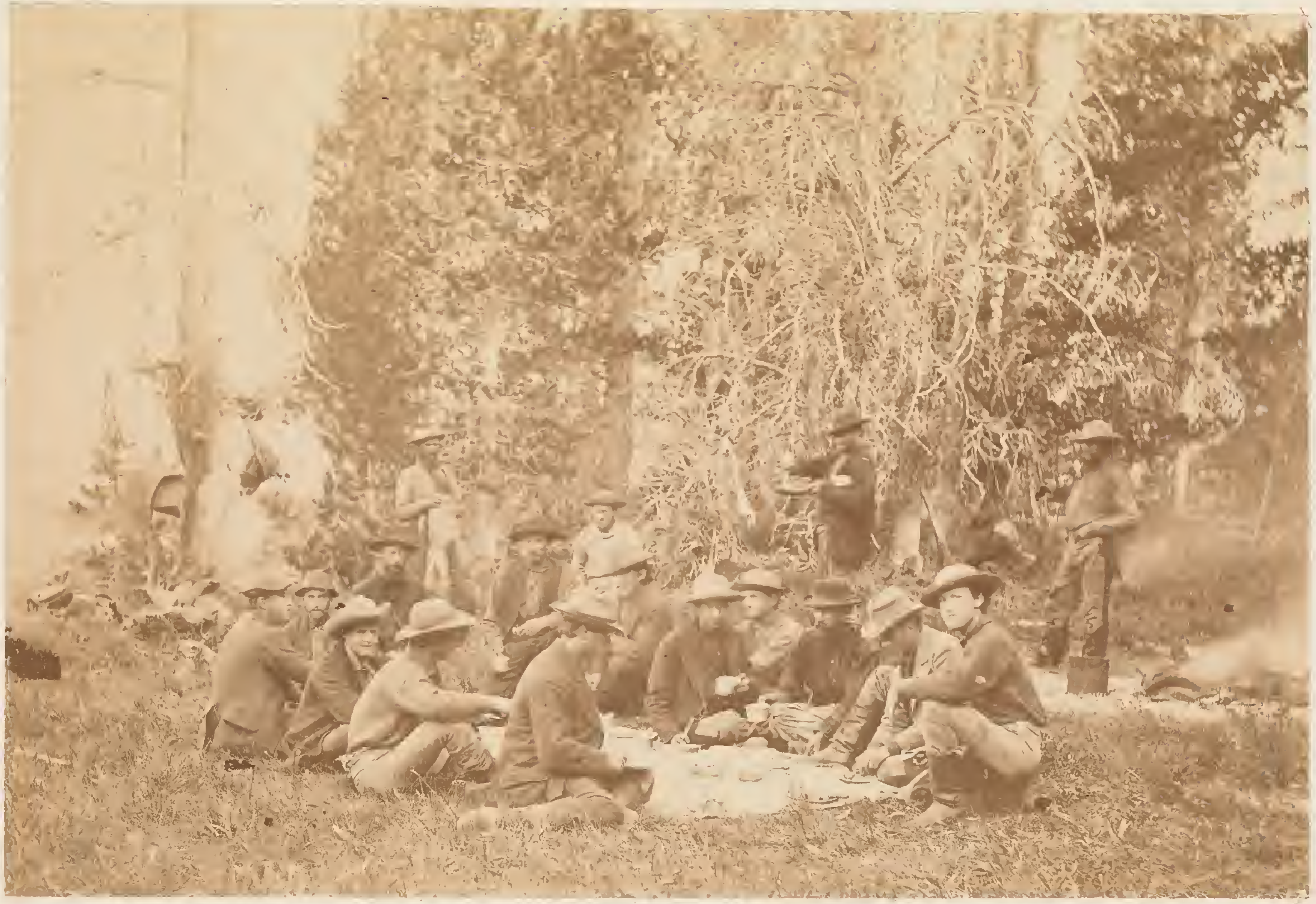
the day was far gone. Went with Peale, he on a mule and I on a pony, to work up the Geology of Spring Canon. Passed through the Canon and a mile above to examine a coal bed, which had been worked to some extent. Found the owner in his bank inspecting. He took us to his ranch and gave us a superb dinner, good coffee, bread, butter, ham and apple sauce. We gathered fossils on the ridge and returned to camp through the Canon.

The party was joined by William Blackmore, the English traveler and museum founder, and we set out for our explorations, I on a nice little pet horse of my own choosing which required a vast deal of beating and spurring to enable me to keep up with Hayden and Blackmore on their fine mounts. The riding was rapid and we scurried from valley to valley and mountain to mountain, examining the rocks and I sketching whatever seemed of particular interest, and in the evening we camped on a creek near its entrance to the Yellowstone River. We camped next near Boetlers Ranch, occupied by the two Boetler brothers, the only settlers so far in the valley. The younger brother became our hunter and kept us in deer and elk meat during the [illegible] trip. The next camp was at Cinnabar Mountain, and I made sketches of the "Devil Slide" (see the 1872 Report) and the great ranges north of the river.

We visited Bridger Mountain and found at its base cretaceous fossils, and on the twelfth a number of us set out on a journey to Mystic Lake. I started from Camp leading a yellow pack mule. At the Suttlers we overtook Burck and the Odometer.

As soon as he could get out - having a story to finish first - he elevated himself into the saddle and like a mighty hero led the party out. We found the trail a horribly bad one - almost impassible - over mountains and through fallen timber. Four miles travel brought us to the foot of Mt. Ellis. Climbing the side of which we passed around to the left of the summit and descended a precipitous slope.

The Odometer was now left far behind and Colonel Stevenson fretted very much at our rate of speed. With many interesting episodes and much fine scenery, we hurried on and about four o'clock caught our first glimpse of a lake. Nestled in a deep valley among the mountains it recalled forcibly my impressions of Switz scenery. It was indeed a very small lake, scarcely more than a pond apparently, everything else about being built on so large a scale. Almost all the mountain slopes are covered with trees, but bordering the valley on the South is a mountain range that lifted its bare, broken volcanic peaks far up above the surrounding ridges. Passing down a fresh green meadow through which a clear stream of water flowed, we came upon the camp of Col. Baker, commander of Fort Ellis, noted as the exterminator of a Piegan Indian town. He with some friends had been spending a few days here. We passed around to the West and South of the lake and camped on a bare plateau a hundred feet or more above the lake level. Disposing of our stock we hastened down to fish for trout. The lake is literally full of them and we had some very fine ones, if not for supper at least



Peale Savage Smith Bingham Wakefield Smith
Gannett Grey Holmes Hovey Platt Sloane Brown Logan

Camp dinner in the park, before separation of parties, 1872

for breakfast. We slept and slept well that night in the open air and in the morning went to work. The Odometer party started back to Camp. Peale, Platt, Savage and I were left.

During the day I made some sketches in the Canon below the lake, and Camp was made on a very fine bed of fossils. While on a steep bank or slope above the creek I noticed a strange little bird flitting along the water edge. On the opposite side a large stream of water poured out of the cliff some thirty or forty feet high and poured in white dashing torrents down over the moss covered rocks. The strange bird paused before the beautiful cascade flitted for a moment and to my great surprise shot directly through the foaming sheet of waters, and I knew immediately that I had found the home of the Cinculus Americanus - the Water ousel. Descending to the foot of the fall, I attempted to see through and behind the falling water, but this was quite impossible, and in trying to reach through at the place where the bird had disappeared I was dashed away dripping wet by the force of the heavy torrent.

The next day Platt went with me and by using a gum blanket to shield off the water the nest was easily found. It contained three young. Returning to camp I found Peale at work arranging camp. He went with me up the slope among the trees and rocks to visit some little lakes. We found them perfect gems, the most charming sheets of water I have ever seen. They were small, the two largest covering perhaps an acre of ground each. The first was set in a rim of Breceia surrounded

by grass and pine trees all of which were reflected in a most perfect manner in the bright emerald water. (The green was most remarkable) The dull green of the pines was changed in the reflection to a glossy prussian green and the color of the sky to a much darker blue. The next was not as bright but still beautiful. I took the privilege of naming the first Emerald and the second "Dolly Varden" Lake. We returned through the winding trail, trees and mountains to Ellis. The evening was cool and a peculiar blue mist filled the air rendering the scenery very fine. A view of Bridger Peak blue in the distance with the purple foot hills and the yellow plain spotted with cattle and flowers (blue and yellow and purple) was most charming. Before leaving Fort Ellis we made a number of trips - two to Bridger Peak.

Yesterday Mrs. Blackmore was buried.* The stage trip must at least in part have been the cause of her illness and sudden death.

On the twentieth of July we broke camp at Fort Ellis. Dr. Hayden and Mr. Blackmore ahead - I in their wake and the train following. We passed around Spring Canon to the coal mine. Passed our provision wagon which had started yesterday. Camped by a little stream near the divide between the Gallatin and Yellowstone. Ascended a high hill with Gannet and Peale.

July Twenty-first: In the morning went with the Doctor and Peale up the mountain to the left. Led my horse much of

*Sir William and Mrs. Blackmore were with the Survey as guests of Dr. Hayden.

the way. Saw many fine flowers - spring flowers - just in bloom, violets, spring beauties, anemones, buttercups, lillies and many others. Got a fine view of the Yellowstone River and the Snowy range from the last mountain ridge. Took a sketch, had lunch and descended. Met Peale when I reached the trail and hurried down Trail creek through hail and rain. Turned to the right as directed by a paper left under a stone, reached camp at eight mile creek.

The Yellowstone River.

July Twenty-second: In the morning ascended a mountain to the right of camp to the height of 2600 feet, a number of the boys along, - saw grouse, big rabbits and an antelope. In descending I was in advance and came into view of a herd of thirty antelope. Reached camp near Bottlers ranch at about five o'clock. Hank Bottler had killed a black tail deer and we lived well. The mosquitoes were extremely bad. Crossed the River in a boat with Fred Bottler to make a sketch from the other side, - dipped my hands for the first time into the waters of the Yellowstone. The stream is clear, cool and very rapid. The cottonwood trees along the banks are most picturesque and the mountains are truly grand. Made my sketch and chased a couple of antelope over the hills for an hour. Visited a beautiful little lake a few miles further up. The pebbly rim beats anything I ever saw. The fine beautifully colored pebbles were so clean that it was impossible to make the water muddy.

Returned sore footed to camp, getting a drink of choice milk as we passed the Ranche.

In the morning we cut our way through the mesquites and reached the second Canyon of the Yellowstone in the afternoon. Camped near the river on the bank of a creek. Bruno and the Indian Officials came to camp and took Mr. Blackmore away to the Mission.

July Twenty-fifth: In the morning I started off with the Doctor up the Canyon a short distance and then up a ravine through the brush and rocks to the mountains, passed a pretty lake and had a shot at an antelope. Ascended a peak 2200 feet, passed down through a deep valley, across a creek by a wigwam of saplings and a beautiful little lake, around the Devil's Slide, down a very steep precipice to camp at the base of the great slide. The Doctor had come in ahead of me and hurried me up to get my dinner and go with him to make a section of a geological outcrop. We ascended to the ridge, I went much higher than he and came down between the two wonderful walls of rock of the Devil's Slide, ten or twenty feet thick and one hundred or one hundred and fifty feet in height. It was dark before I got to camp.

July Twenty-sixth: In the morning, I stopped behind the train to make drawings, found some fossil ammonites. Lost my hammer and hurried forward to the hot springs. Turned up Gardiners River but had some difficulty in finding camp. Peale, Ganett and Brown were all day and all night on Electric Mountain

where they had some strange experiences. Savage and Bottler were out together. Bottler killed a she bear and two cubs. It is hardly worth while to attempt to describe the "Springs" one of the greatest wonders of the world. The wonderful beauty of form and color displayed cannot be described, painted or even recalled by one who has visited them.

July Twenty-seventh: When breakfast was over I started out with the Doctor across the hills to the head of the Springs half a mile away - I led the Doctor through a bad road, but he was busy talking and we reached the glen spring in good spirits. In passing through the pines, we were surprised by hearing a strange sound. I thought at first that it was a mountain squirrel, afterwards that it was a sort of guttural blubbering. Suddenly we came upon a large hot spring mound and from various conical craters, the steam and water were issuing - some fizzing - some blubbering - some spouting. From one opening in the top of the mound, the water was thrown for some three or four feet. As the water flowed down the irregular sides of the mound, the various materials in solution were deposited leaving many varied forms and fantastic colors. After making a sketch we hurried on among vast ruins where walls and mounds had been built up and left to decay. Among these were still a few springs eking out a sickly existence, but we had to pass over many acres of ruins before we came to the active springs proper. After a while the Doctor left me and I went on with my drawing, attempting some coloring, but found it very difficult

to get satisfactory notes. Christman was at work photographing and as I stood before a most perfect Spring, I found myself taken in.

July Twenty-eighth: The next day I made a drawing of the mountains east of the Springs and afterward made some very good sketches among the Springs.

July Thirtieth: Spent a few hours at the Springs then passed down Gardiners River with Ganett and Brown crossed the little bridge and made some sketches in the mouth of the Canyon. Lost my knife and hurried on alone through the very cold wind and found camp on Blacktail Deer Creek. There seems to be no trail up this part of the Canyon, but in the morning Doctor, Mr. Blackmore, Billy Hamilton and myself rode down to the brink of the Canyon which seemed very difficult to ascend. As I stopped to make a sketch they went ahead and I had to find the way down alone. Followed their trail for a time but lost it. Spent an hour looking for a place to descend. In passing up a bank came upon an antelope, left my horse and slipped up to him with my pistol, got within twenty yards fired and wounded him, but after firing four other shots failed to get him.

Soon after I succeeded in getting down into the Canyon, the others had entered lower and had passed up stream. Encountered some beautiful lakes. Saw many fine things in the great Canyon - the white foaming water, the steep and high cliffs and the great mountains. Started up a ridge and after traveling a few miles found camp. Next day we outfitted a small party and started on

a side trip to the mining camps of Clarks Fork. There were the Doctor, Mr. Blackmore and his men, myself and a number of others who were going but part of the way. A number of miles up the East fork we met Jack Burnett, one of the miners who had brought down some specimens to the Doctor. We camped near the Soda Butte - a hot spring cone - had some fine trout fishing in the river.

In the morning the Odometer party returned and we started up Soda Butte Fork. The Butte is about twenty feet high - a hot spring cone. I made sketches and had also to keep up a section sketch of the West Side of the Creek. We pressed hurriedly through twenty-five miles of extraordinary scenery - certainly rivalling Yosemite. The mountains were curious and grand, many grotesque, many architectural forms. I got behind during the last part of the day. After traveling a long while alone and shooting a sage hen with my pistol, I came upon Billy Hamilton, who was waiting for me to show me the way to the Miners Camp. We had some trouble finding camp, reaching it we found all hands there - Blackmore, Hayden, Jack Bean, Jack Burnett, Sloan and one or two others. Made drawings of an odd white rabbit (herewith with episodes vol 1). Saw the fine leads of ore, had supper and went to bed.

July Thirty-first: Our party with a number of the hunter-prospecters prepared to cross to the head of Slough Creek. We went down, crossed the creek and ascended a very steep mountain. Saw some of the finest groups of pine trees possible. No park ever saw such tall, straight and tapering

forms - a dozen in a group forming a great cone. Thick, heavy-topped gnarled old fellows, very picturesque indeed.

Ascended a mountain near the divide to a height of nearly 10,000 feet. Made a panoramic sketch of the surrounding mountains. On the East were the turreted peaks, immensely high, of the Index and Pilot Mountains. Away off younder over the Hart Mountains on the lower Yellowstone, - in between was Clarks Fork - near the source, a chain of beautiful lakes, lying among a great mass of volcanic mountain heaps, irregular, desolate and wild. Farther toward the north were immense ranges of mountains with pyramidal and spiral peaks, so steep that the snow could not lie within 2,000 feet of the tops. Threads of snow lined well marked crevices. To our left arose and flowed down among these peaks into regions of unknown wildness the romantic Rosebud, with its superb spring flowers and a snowy divide, its Canyon and ten miles of cascades with its granite moss grown rocks, its foaming waters, its symmetric pines and its birds, and deer and bears.

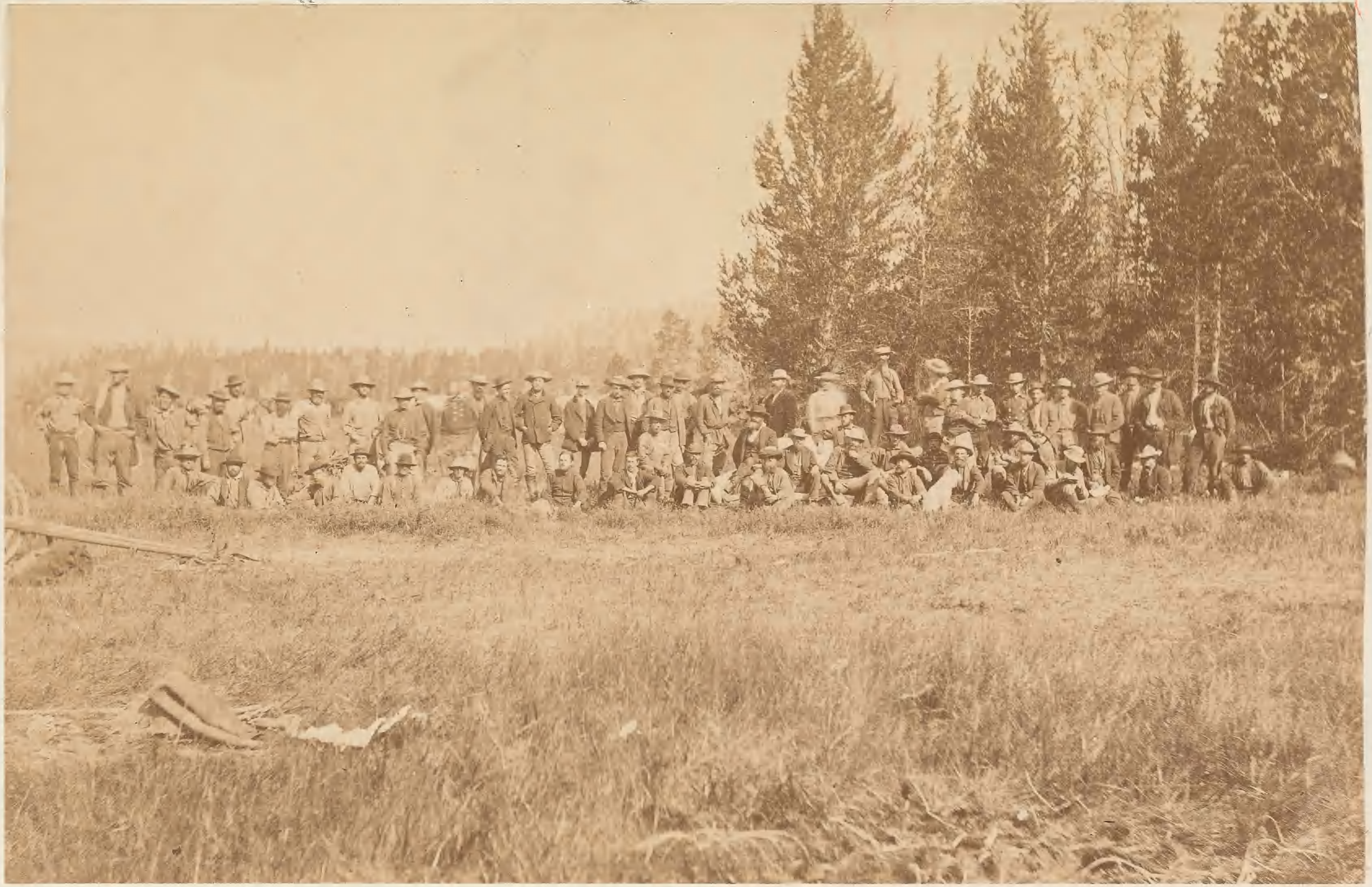
To our left at the source of Slough Creek was a little lake and over it far away appeared the crest of Emigrant Peak, farther to the West we could see the square outline of Electric Peak and from this around to the South a wilderness of immense volcanic mountains.

Doctor, Hayden and I now followed Blackmore down the mountain to a little lake two or three miles away - camp - cooking - fishing - hunting and sketching. Rapid travel down

John Raymond
Cox
Carrington

Taggart
Negley
Coulter Bec
~~Holman~~
Jackson Adams
Brechly
Herring

Bradley, Curtis
Langford Hill
Hayden
Sir Wm Blackmore
Stevenson
Holmes
Logan
Bill Hamilton
Gannett
Peale platt
Brown
Savage
Goodfellow



The Hayden Survey party (60) shortly after reaching the park, Jackson photo, 1872

In [illegible] [illegible] [illegible]

slough creek - rain - camp below bridge. Beautiful Amethyst. Lighting out in the morning - Great Canyon - Basaltic Column - Colors - Lower Falls - Mt. Washburn - lost - camp in forest - Hot Springs in the morning - Running off of pack horse and hunt for camp - Runaway horse - Christman's Camp - In Glimpse of Great and Upper Falls - Camp over the Ridge - Walk back to Falls - Grand View.

Yellowstone Lake.

Notes of Color and Form - Return to Camp - Cascade Creek - Preparing in the morning for another side trip to the Lake - Stop of an hour at Falls - Ascent of river - Banks low - Crater hill - beautiful geyser spring - mud pots - birds-eye view - Hunting camp at Great Mud Geyser - Arch Spring - Devils Caldron.

Start for lake in morning - killing wolverine - First view of Lake - ducks - geese - pelicans - swans - gulls - Camp for lunch start around Lake - with Doctor, Mr. Blackmore, Wakefield, John and Billy. Entering timber - crossing arms of lake by sand bars. Awful timber - swamps - strawberries - traveling after dark - accident - hunting place for camp - halt - Doctor and Billy ahead in the dark - camp by the Lake - great fire - theatric effect - warm springs in sight in morning - coasting the breakered shore. Hundreds of warm springs- bath - camp - mud puffs - deep springs - boiling a fish - sketching wonderful mountains through field glass - cold day. Hunt for horses in morning. Otter - separated in the woods - all right - hurried

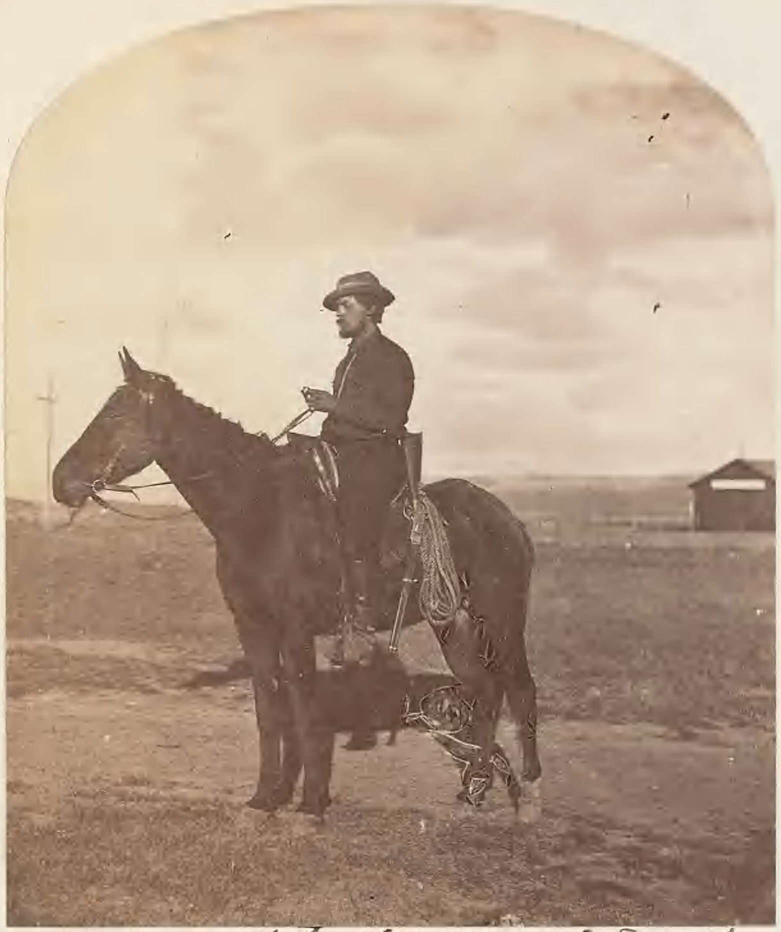
march through to crater hills - arrived in good time in camp at Mud Geyser. Lowe had just killed a bear and a deer - Bottler a deer and five elk - visit to place of slaughter next day (see photo) - return with two pack mules of meat - watching Geyser - start to Geyser Basin with Blackmore.

The fifth and sixth nights were spent at the wonderful Mammouth Hot Springs and the next at the first creek before reaching Yellowstone Lake. From this camp we passed Tower Falls and crossed the ridge of Mount Washburne, making camp near the Great Falls of the Yellowstone. Here we spent a day or two geologizing and studying the great cataracts and the upper and lower falls. On our way to the next camp at Mud Geyser we came upon our hunter in the pine forest where he had shot three splendid elk almost in a heap (see photograph). From the Mud Geyser we set out through the forest for Yellowstone Lake, which we reached long after dark and after various adventures, amusing and serious. After dark my horse became obstreperous while struggling through a stretch of fallen timber on the slope overlooking the lake, and I got off just in time to realize that he had thrown himself over the logs and had disappeared in the darkness. In a moment all was quiet and Dr. Hayden, who was following, began to shout in great excitement, "There you have done it; he is in the lake; I hear him splashing!" The lake was splashing of its own accord, and I soon found the fool horse lying quietly among the logs. I soon got him up and we struggled along until an open space was found on

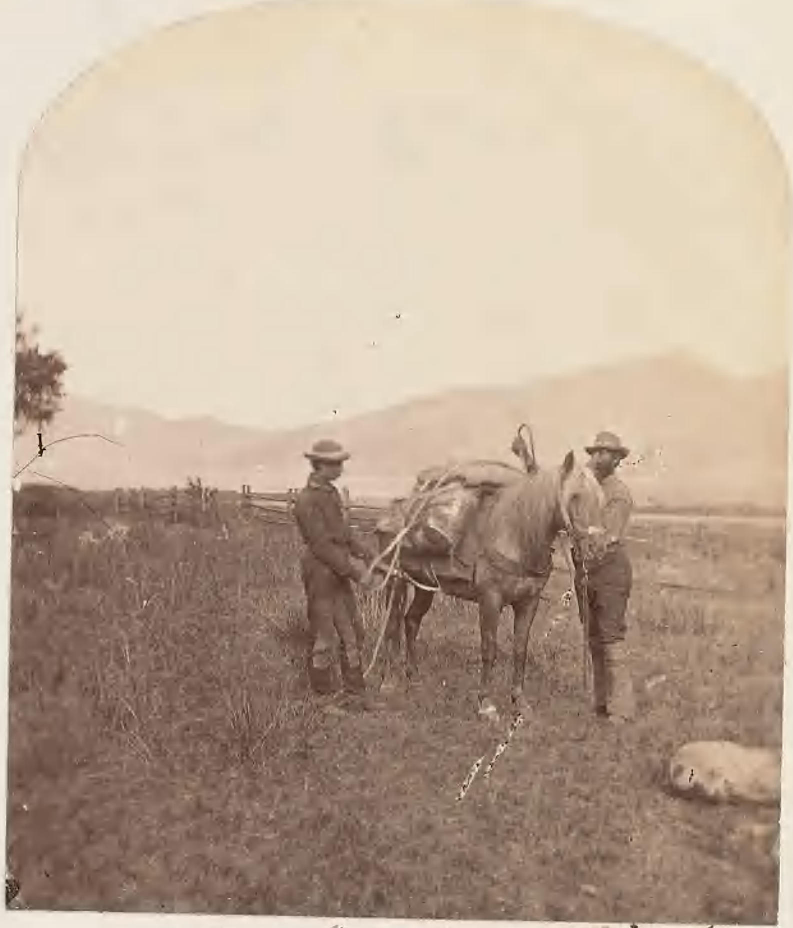
the bank of the lake. The next move was to the shore of the west arm of the lake, where we found some interesting hot springs, in one of which (see my sketch in the 1872 Report) Blackmore and I may be seen standing on the rim of the spring where we were engaged in catching trout in the lake and without taking them off the hook cooking them in the spring. This feat has often been recorded in succeeding years by excursionists and writers of books.

In the morning the party set out toward the West through the forest to find the lower geyser basin. I was now working much of the time alone, and one day, going through the open forest, had my first experience at being lost. I had dismounted to look at a stone and a moment later rose and looked about me with the view of continuing my ride, but the forest was all alike on all sides and my horse had not left a mark on the beds of scrubby dew berry bushes. Just for the moment I had the queer and rather shocking sensation of being lost, but recovering I began to circle about and finally found impressions of my horses hoofs showing which way I had come, and I was soon on my way again to the West and late in the evening found camp on a small stream in the deep forest.

1870



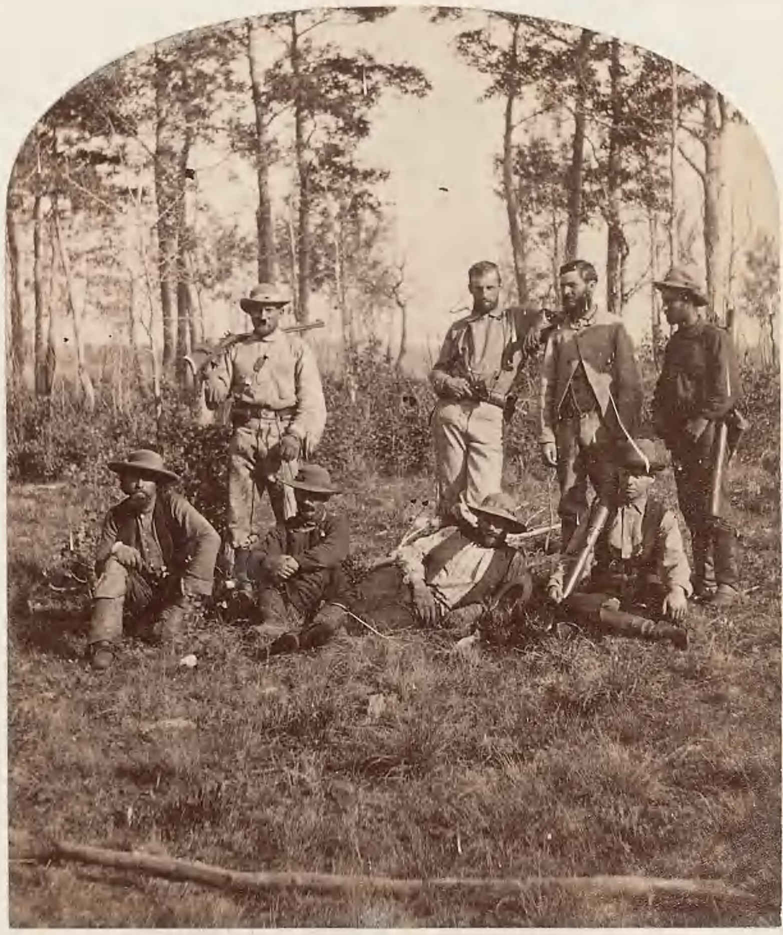
W.H. Jackson. Photographer



Gov. Langford. & Bingham
Packing. 1872

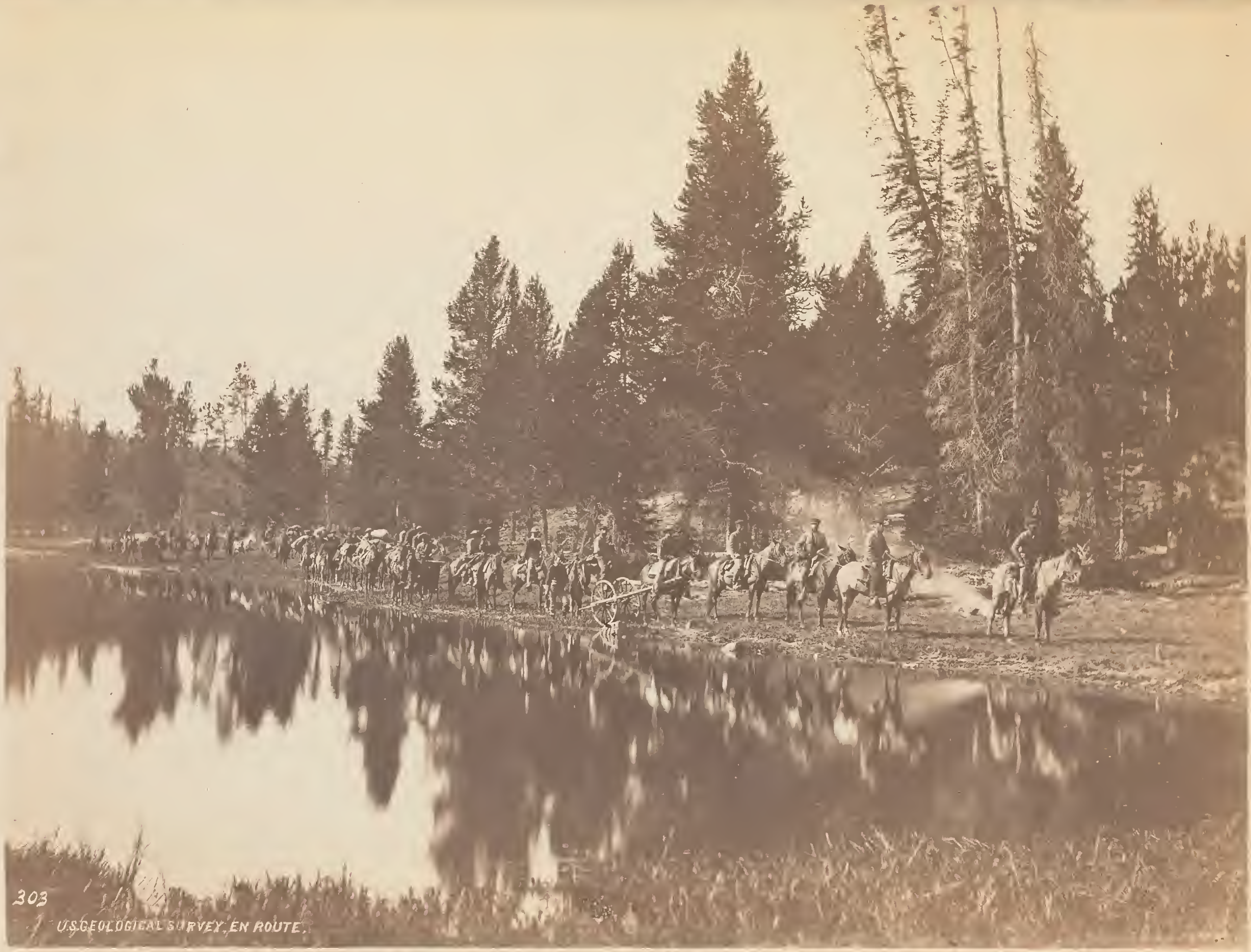
Yellowstone

Pack Mule



Packer
Jaunt. Hunter
Holmes, Artist
Endlich geologist
Wilson
Chittenden } topogs.

COLORADO, 1873



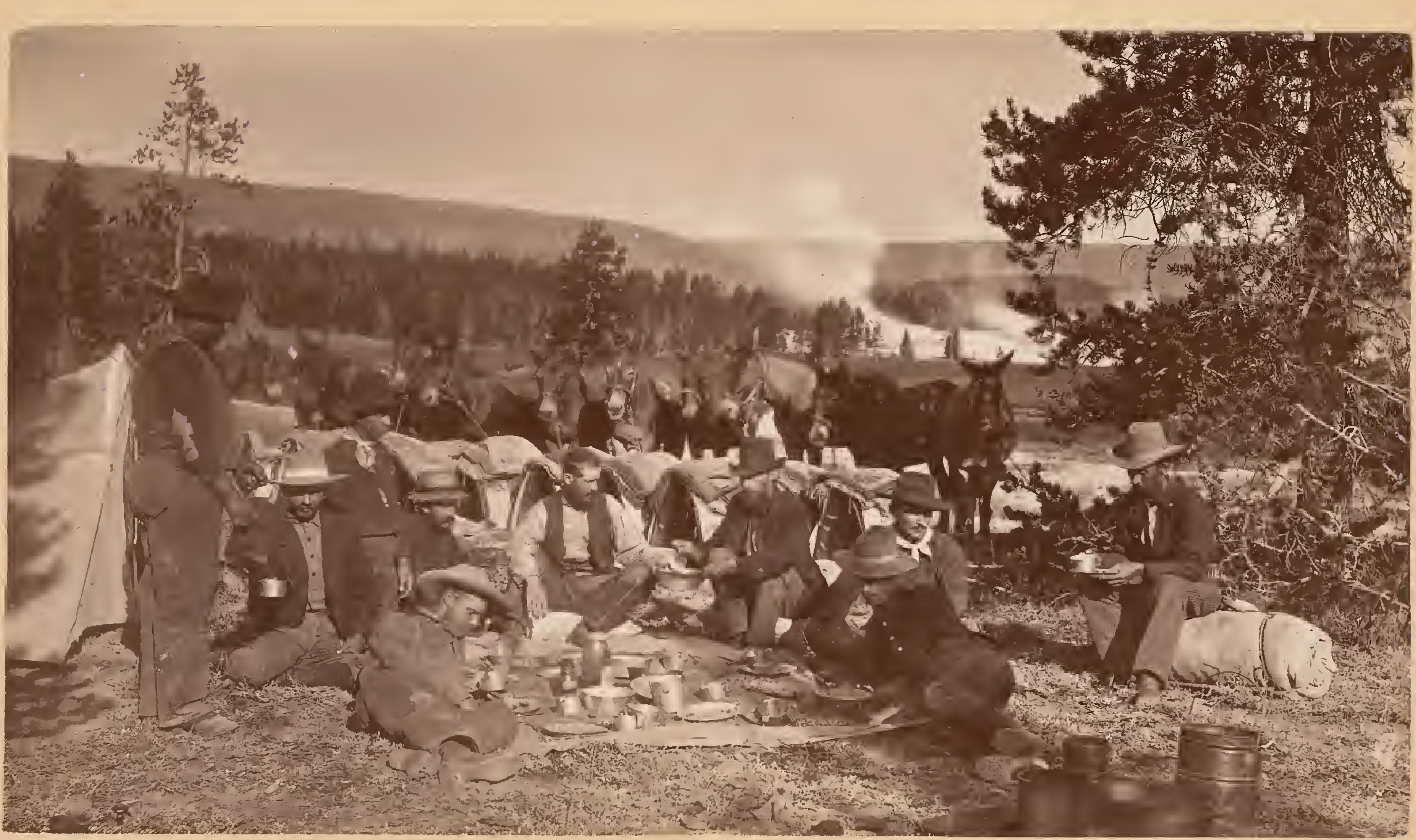
303

U.S.GEOLOGICAL SURVEY, EN ROUTE.

Hayden Survey party, 1871.

Hayden. Sloane,

DEPARTMENT OF THE INTERIOR. F. V. HAYDEN IN CHARGE. U.S. GEOLOGICAL SURVEY OF THE TERRITORIES



The Cook

Peale

Amelung

Gannett

Hayden

Cooper

Holmes

Hayden party in Yellowstone park, 1872

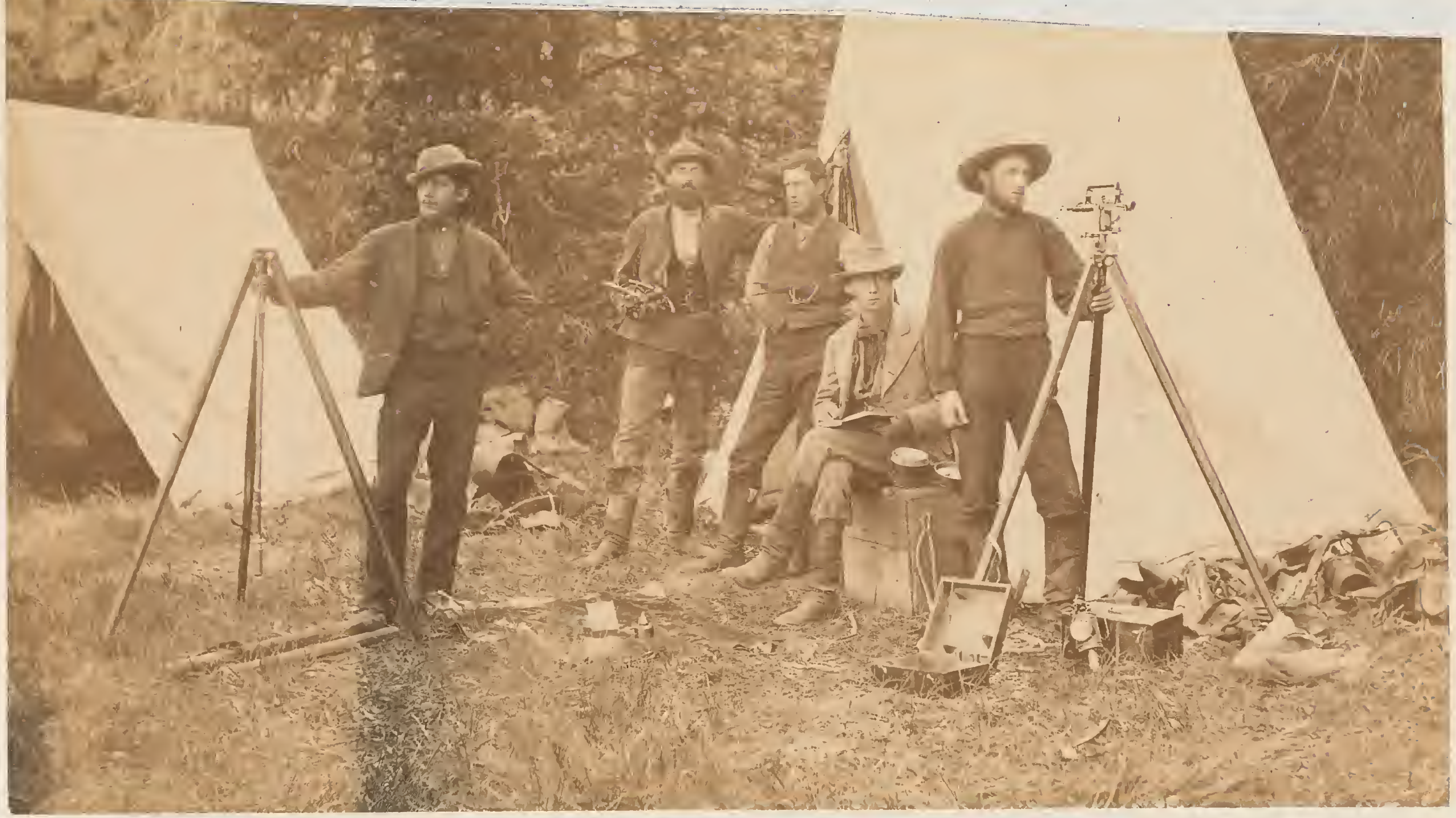
W. H. JACKSON, PHOTO.

W H Holmes

VIEWS IN THE ROCKY MOUNTAINS

Hayden Survey-- Yellowstone Expedition, 1872 W. H. Jackson, Photographer

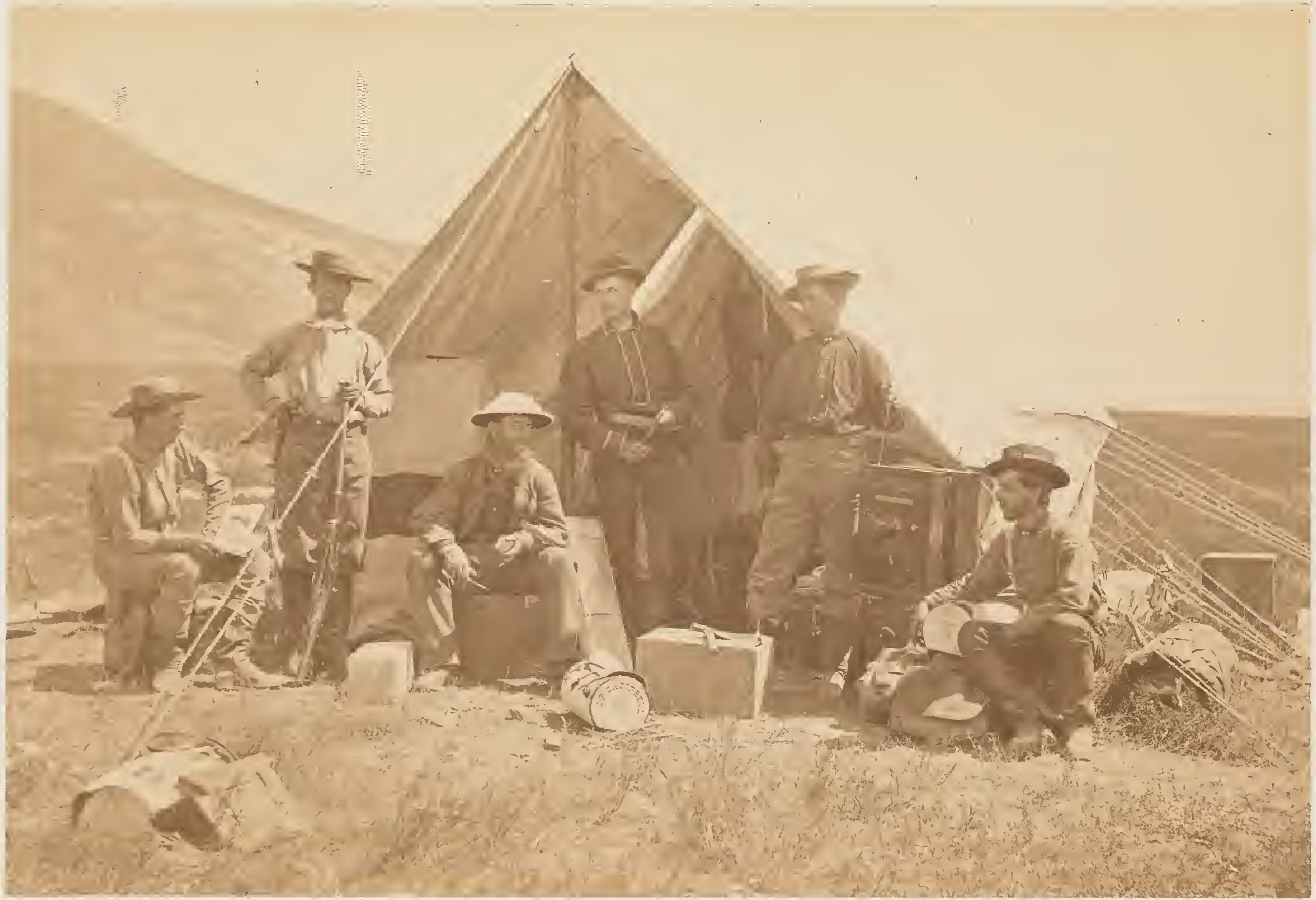
Left to right :Prof. E. B. Wakefield of Hiram College, Meteorologist
* correct spelling Rudolph *Hering, Asst. Topographer(Hering has only 1 r)
Henry Gannett, Astronomer (In charge of field work of the Yellowstone Div
Alexander Ephraim Brown, Asst. Topographer
Thomas W. Jaycox, Asst. Topographer
Credit Line: The Smithsonian Institution Neg. No. 32113-D (MHT)



Wakefield Herring Brown Jaycox
Gannett

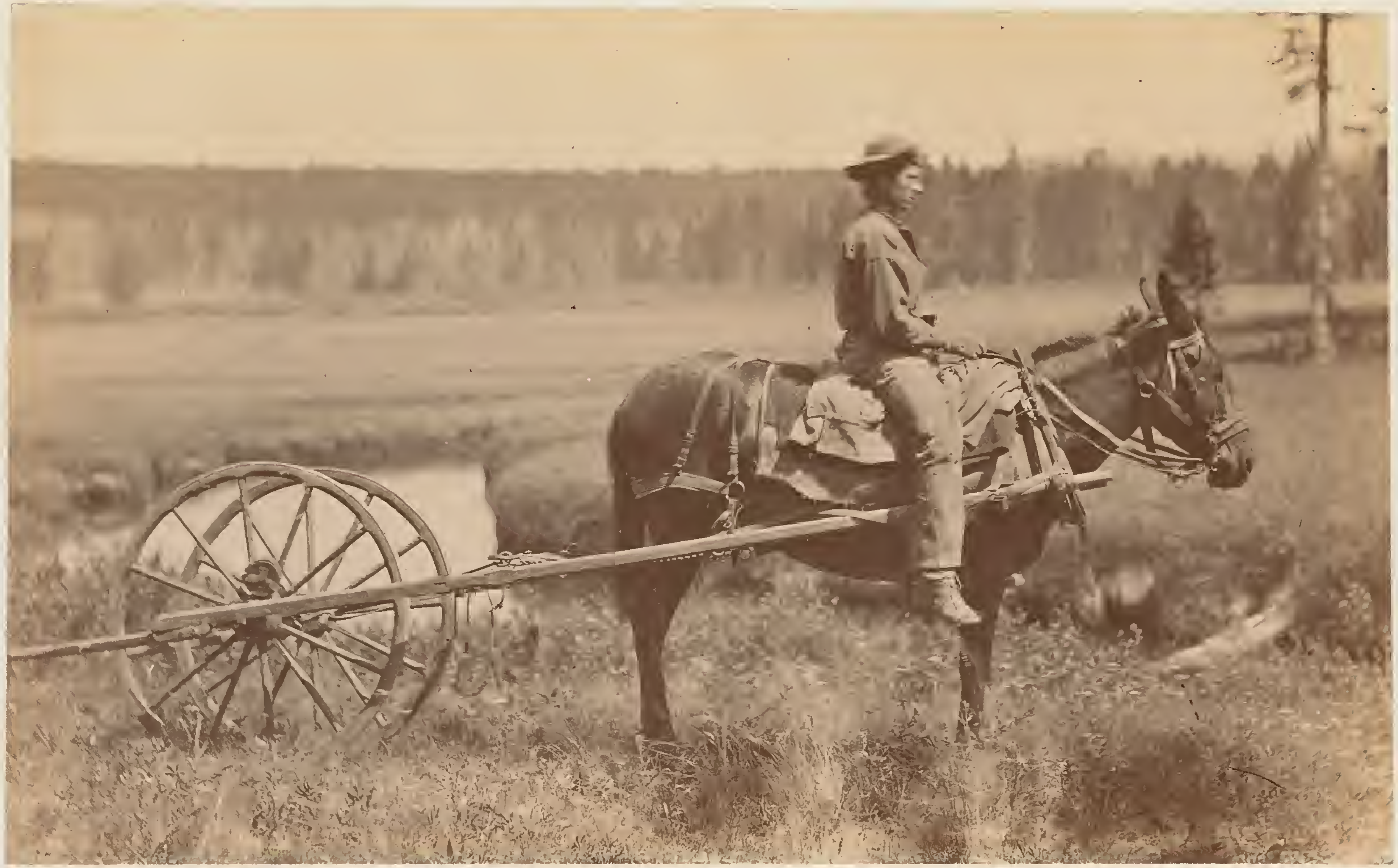
Yellowstone Expedition, 1872

Hayden Survey, 1872



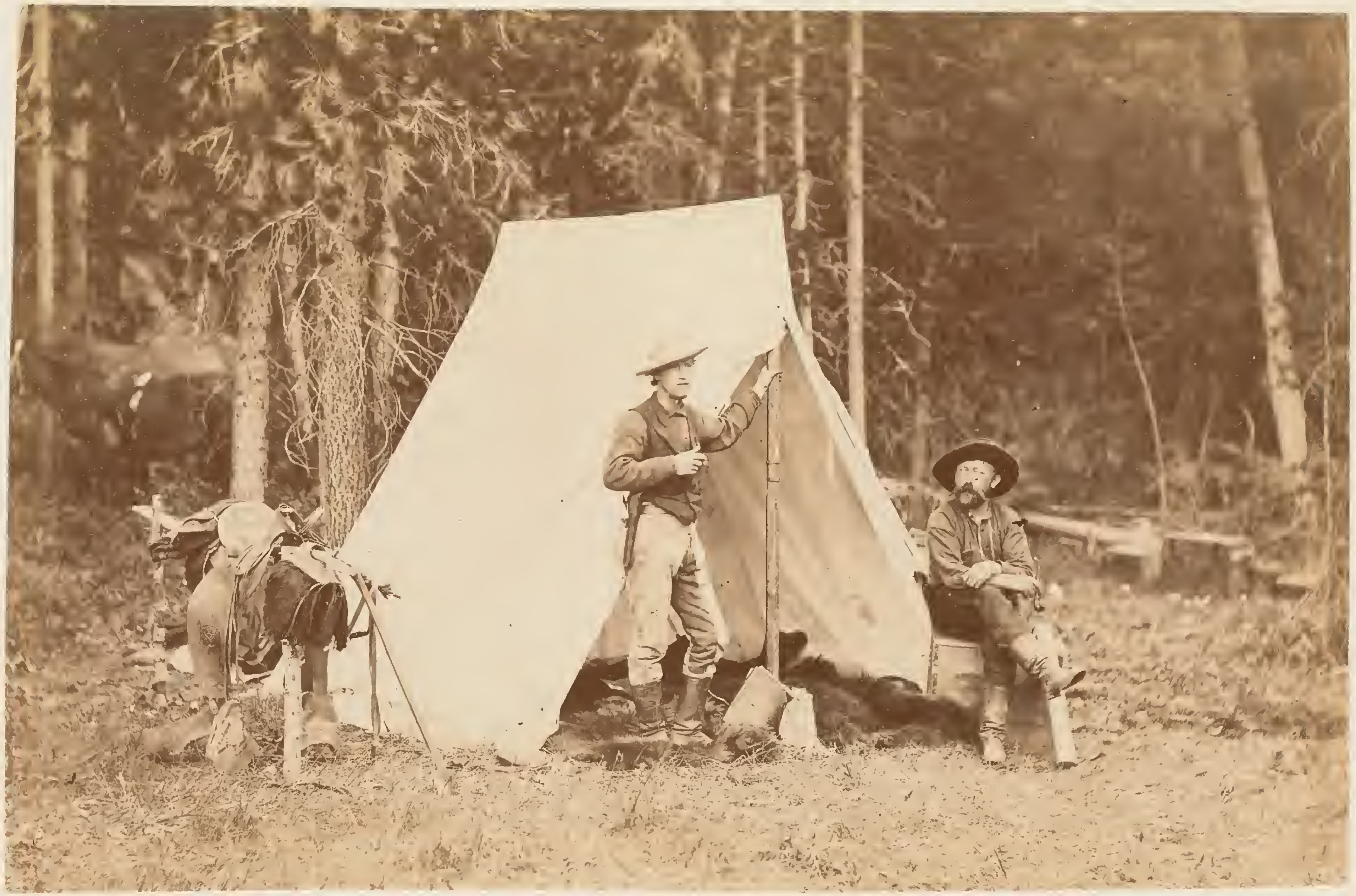
Holmes, (artist) Campbell Bradley (Geologist) John M Coulter, (Botanist) Jackson (Photo) Peale (Geologist)

In camp near Ogden. Ready for the start to the Yellowstone, 1872



The Odometer records the distances, Run by Mr. Goodfellow. 1872

[illegible]

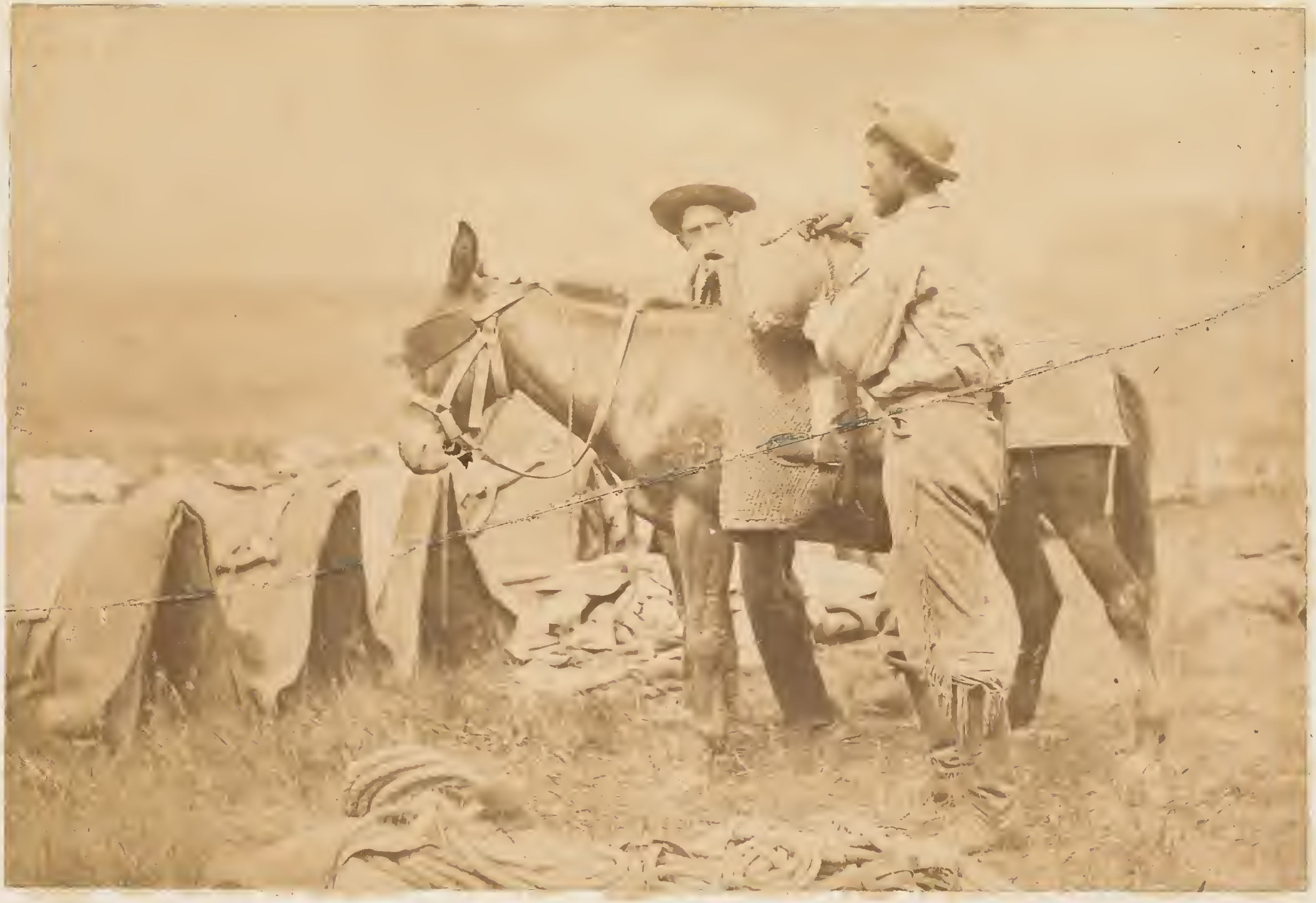


"Billy" Logan
nephew of Senator Logan

Burke, topographer

Hayden Yellowstone Expedition 1872

[illegible] 32113-C.



Adjusting the pack:- a fine art; Shep. Madera and assistant
Yellowstone 1872

HE GREAT FOUNTAIN GEYSER, LOWER GEYSER BASIN, YELLOWSTONE NATIONAL PARK,

DESCRIPTION BY W. H. HOLMES WHO GAVE THE GEYSER ITS NAME IN 1872.

"During our somewhat protracted stay in the lower basin, I found time to observe pretty carefully all the geysers of any considerable importance. Among the six or eight which throw columns of water to the height, say, of 30 feet, there is only one that possesses the dignity and grandeur of the great geysers of the upper basin. Although, in some respects, it is much inferior to its more popular rivals, in others it is certainly superior. In approaching the crater of this geyser the observer is not at first impressed with its importance, as the outer rim of the basin or rather table - in the center of which the fissure is situated - is raised but two or three feet above the general level. This elevated part I should estimate to be upwards of 120 feet in diameter, and, with the exception of the crater, it is built up nearly to a level with the border. The surface, formed entirely of siliceous deposit, is diversified by an infinite number of forms and colors. The depressed parts in some places are so level and white and hard that a name could be engraved as easily and as well as upon the bark of a beech-tree. In others there are most exquisitely modeled basins and pockets, with ornamented rims and filled with perfectly transparent water, through which thousands of white pebbles of geyserite could be seen lying in the white, velvety bottoms. Rising above the general level are innumerable little masses and nodes of cauliflower-like and beaded silica, standing out of the shallow water like so many islands. Those near the crater swell into very

large rounded masses. The whole surface is so solid that I walked, by stepping from one elevation to another, up to the very brink of the fissure, where I looked down with no little apprehension into the seething caldron, where, 12 or 15 feet below, was a mass of dark-green water in a state of constant agitation, threatening an eruption. The crater is about 10 feet in diameter, lined with an irregular coating of beaded silica. The water soon began to rise, plunging from side to side in great surges, sending up masses of steam and emitting angry, rumbling sounds. This demonstration caused a precipitate retreat, on my part, to the border of the basin, thinking that I could appreciate the beauties of a scalding shower-bath better from that point of view.

An irregular mass of water was thrown into the air in the utmost confusion, spreading out at every angle and whirling in every direction, some jets rising vertically to the height of 60 or 80 feet, then separating into large glistening drops and falling back into the whirling mass of water and steam; others shooting at an angle of 45° and falling upon the islands and pools 30 or 40 feet from the base. The eruptive force, for a moment, dies away and the water sinks back into the tube. Then, with another tremendous effort, a second body of water is driven into the air, but with a motion so much more simple than before that the whole mass assumes a more regular form and is like a great fountain with a thousand jets, describing curves almost equal on all sides and forming a symmetrical whole more varied and more grand than any similar work by man. The intermittent action continues for nearly an hour, but is so constantly

changing that at no two moments during that time are the forms or movements the same. The eruptions are repeated at irregular intervals of a few hours and are not known to vary essentially from the manner of action here described; yet I have good reason to believe that at certain times there is a much greater exhibition of power. It must be borne in mind that all the elevations, such as the tubes, rims, and mounds about the crater of a geyser, are built by the evaporation of the water, and the portion of surface covered by the beaded silica indicates precisely the area over which the erupted water falls. In no case did I observe the water fall outside of a circle of 60 feet in diameter, and the additional force necessary to scatter it over twice that amount of surface must produce a display truly magnificent. That this display actually occurs is attested by one of our mountaineers and almost demonstrated by the extent of the beaded surface. During the earlier part of the eruption a considerable quantity of water flows over the rim and down the sides, where it has formed a series of basins somewhat similar in form and color to those at the springs on Gardiner's River. Falling from one to another of these it passes off down the slope and joins a large stream of hot water which issues from a steady spring not far away.

A few hundred yards farther up the ravine, and on the opposite side of the creek, I discovered a small spring that deserves in a quiet way to be one of the great attractions of this attractive region. It is isolated from the neighboring springs and nestled in against an abrupt bank, so obscured by tall pines that the visitor

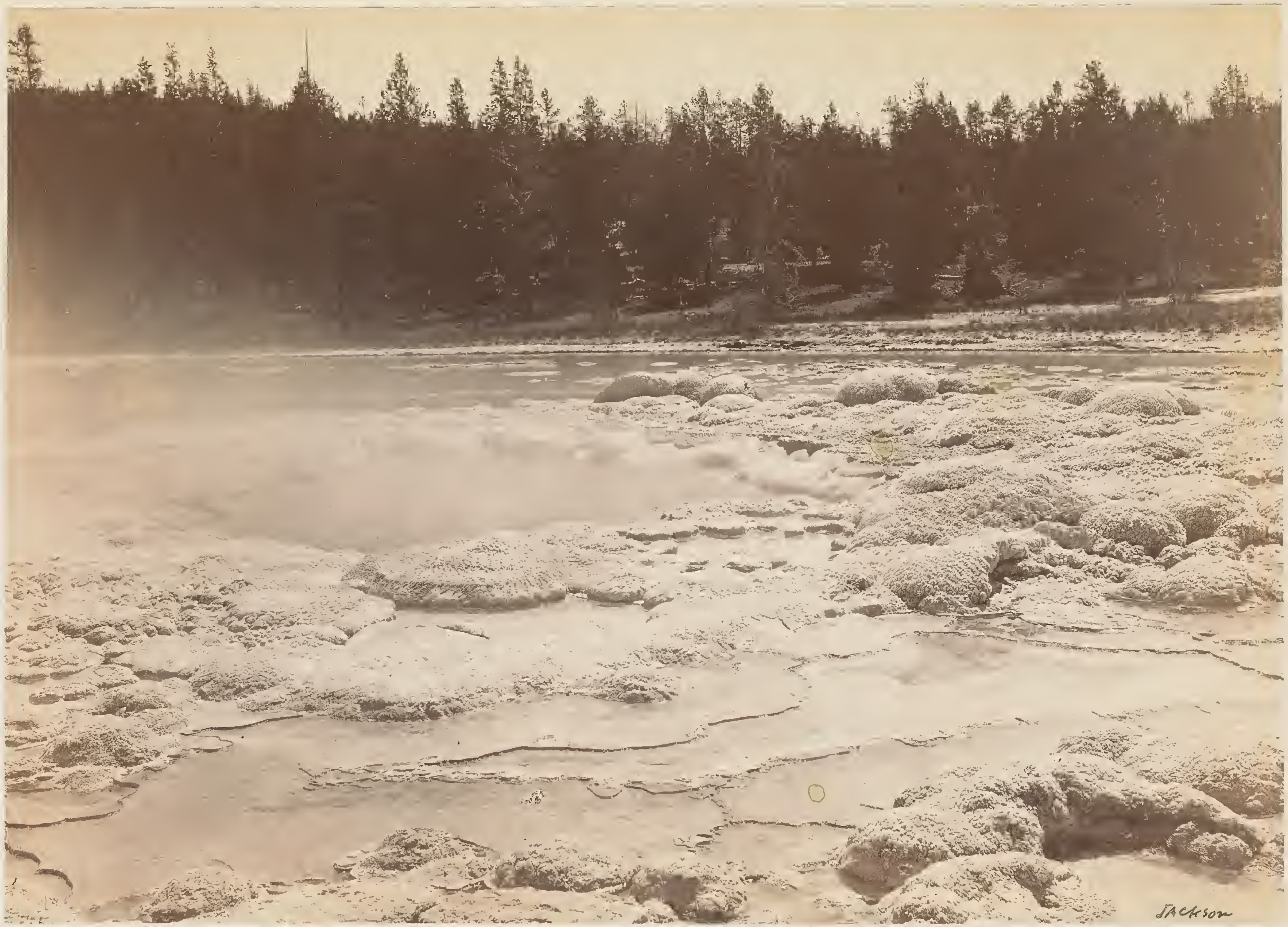
#8

is liable to pass it by unnoticed. In approaching from the creek I passed up a gradually ascending slope down which the water flows, covering in its meanderings more than an acre of ground and leaving, wherever it touches, brilliant streams of color. About a hundred yards from the creek I came upon the spring, the waters of which stand nearly on a level with the surrounding surface. Approaching the border I looked down into the blue mysterious depth and watched the large bubbles of steam slowly rising to the surface and passing off into the air. The larger of these bubbles would lift up a considerable quantity of water sometimes to the height of 3 or 4 feet, producing a kind of spasmodic boiling and dashing a succession of waves against the rim. The spring is surrounded by an irregular rim which stands a few inches above the general level of the water. The basin is 20 feet long and 10 feet wide, one end being narrower and partially separated from the main basin by an irregular row of beaded islands and projections.

Although the spring and basin are very chaste and delicate in form as well as color, there are other springs more beautiful in those respects. But when I ascended the bank and looked down upon the spring and its surroundings, I concluded, without the least hesitation, that I had never seen anything so uniquely beautiful. On the upper side of the spring, next to the bank, the water in overflowing ran into large shallow pools, painting whatever it touched with the colors of the rainbow. Beds of rich, creamy white and rich yellows were interlaid with patches of siennas and purples, and divided up and surrounded by the most fantastic patterns of delicate

grays and rich browns. On the side next the creek the running water has made a net-work of streams. In those where the water is still hot, the colors are bright, varying from a creamy white to the brightest yellows, but, as the water becomes cooler, farther down, the colors grow darker and richer, the siennas greatly predominating, while the basins of the larger pools are stained with still darker colors, frequently of a purple tint and reflecting the picturesque groups of pines on their dark surfaces. Scattered irregularly over the whole surface are numberless little areas of dry deposit, from which the brighter tints have faded but which still retain such a great variety of purple and blue grays that the harmony of the whole field of color is complete."

(Sixth Annual Report of the U. S. Geological Survey of the Territories, 1872, Pages 144 and 145.)



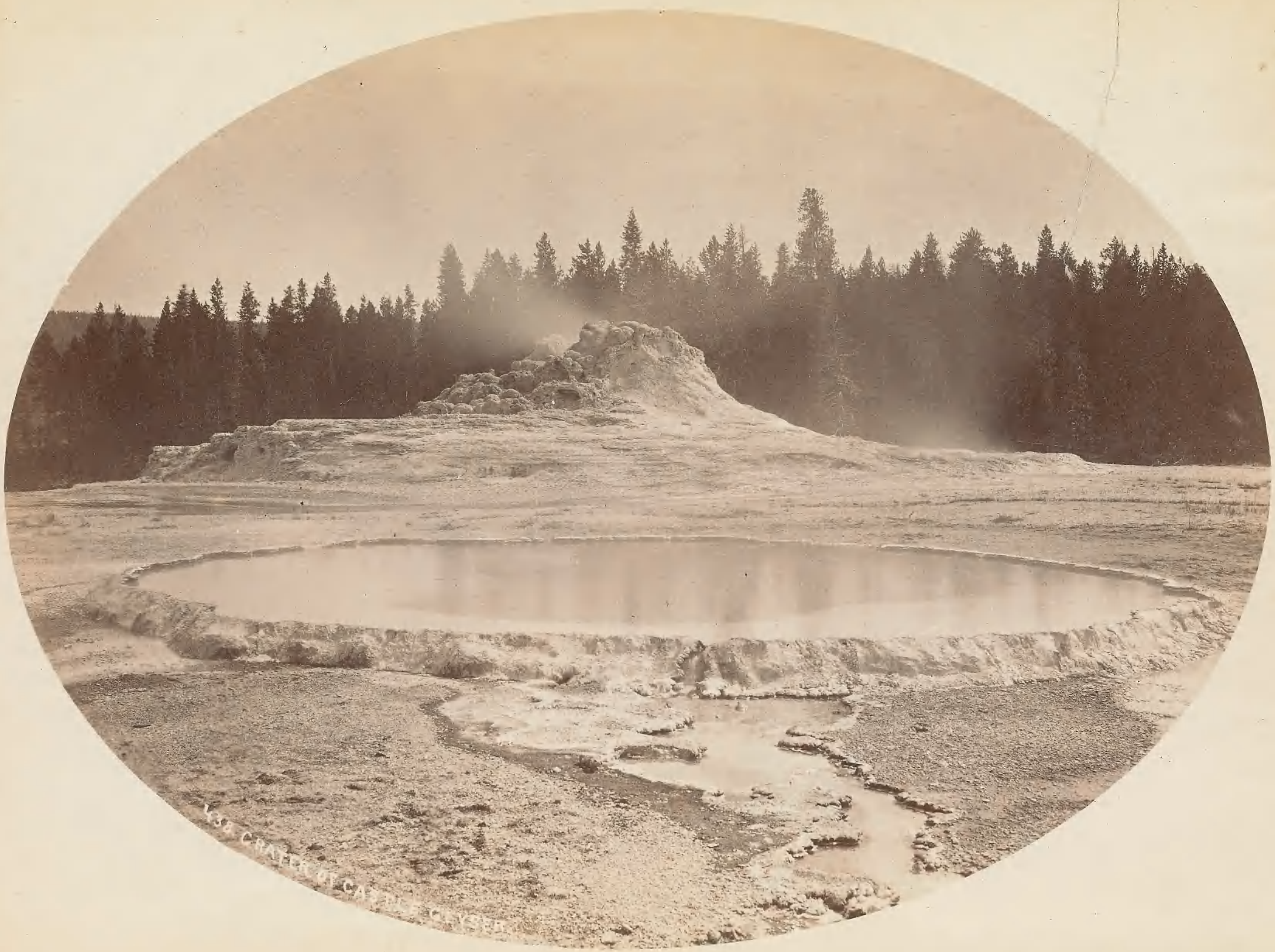
Great Fountain Geyser at rest, with extensive deposits

1872

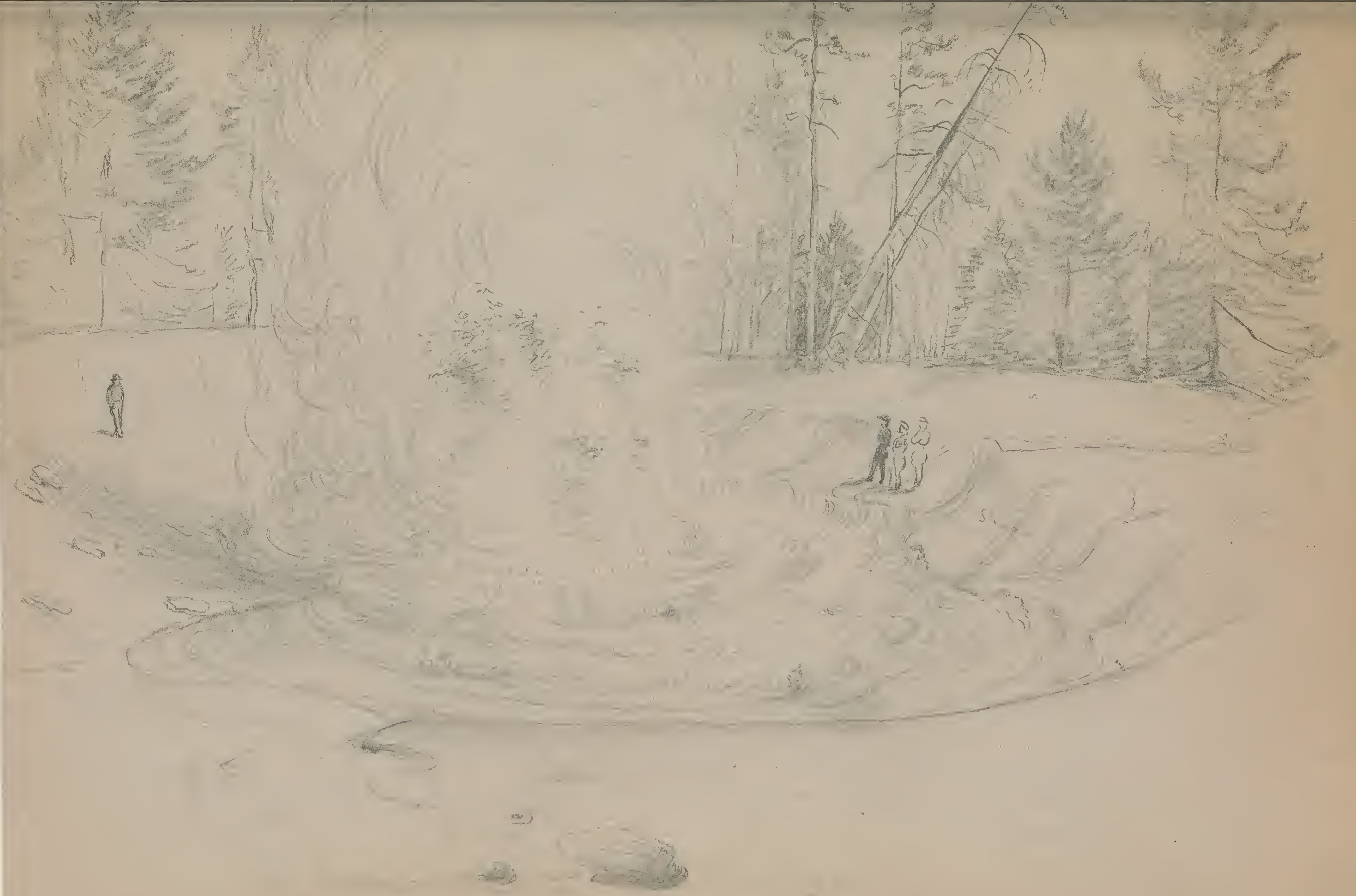
To whom it may concern: (Vol 3
page 51)

This is not a photo of Great Fountain but rather a photo of Castle Geyser (background) and Crested Pool (foreground), both in Upper Geyser Basin, YNP, Wyoming.

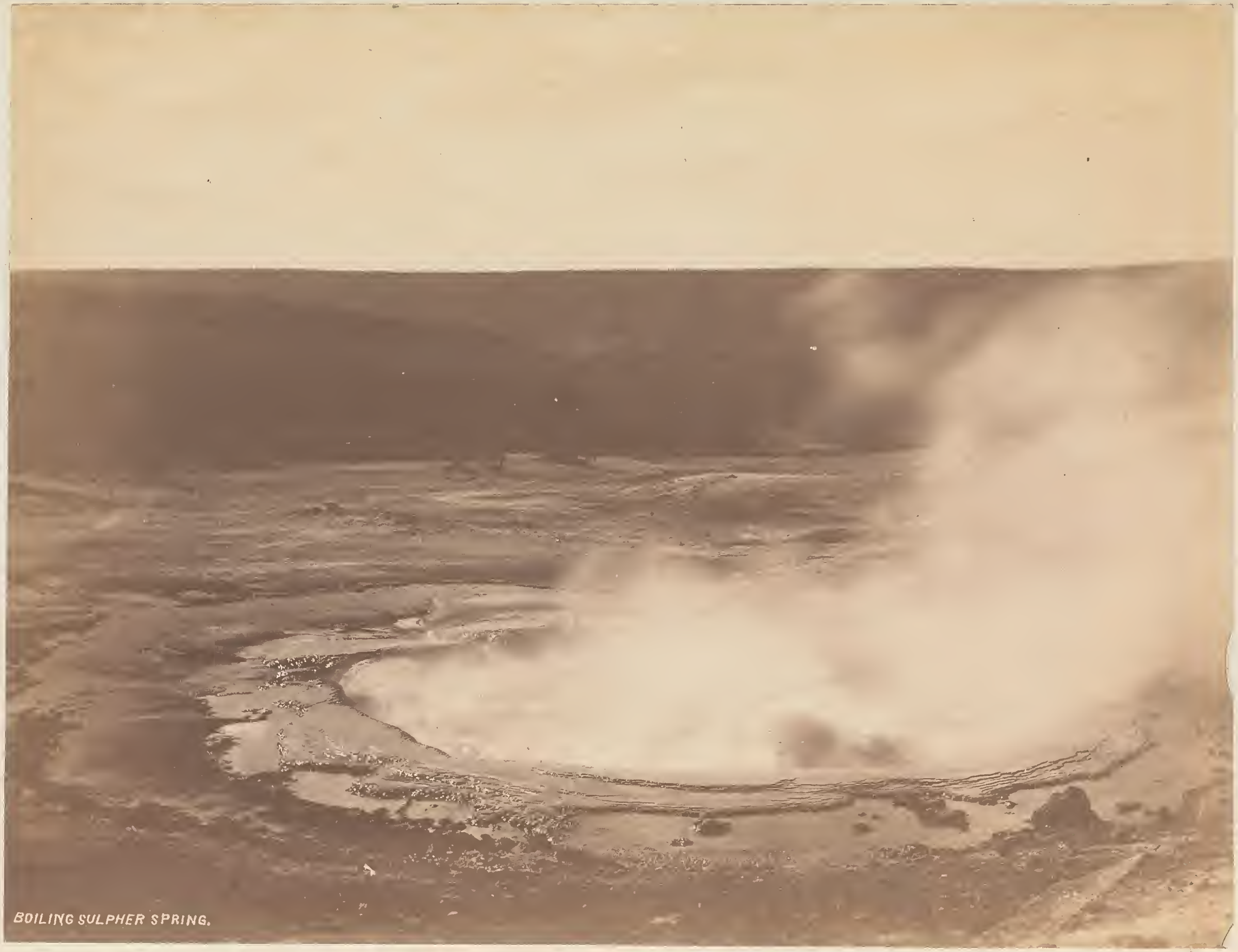
Lee H. Whittlesey
Yellowstone National Park researcher
March 7, 1979


438 CRATER OF CASTLE GEYSER.

The Great Fountain Geyser at rest. Hot-spring in foreground.

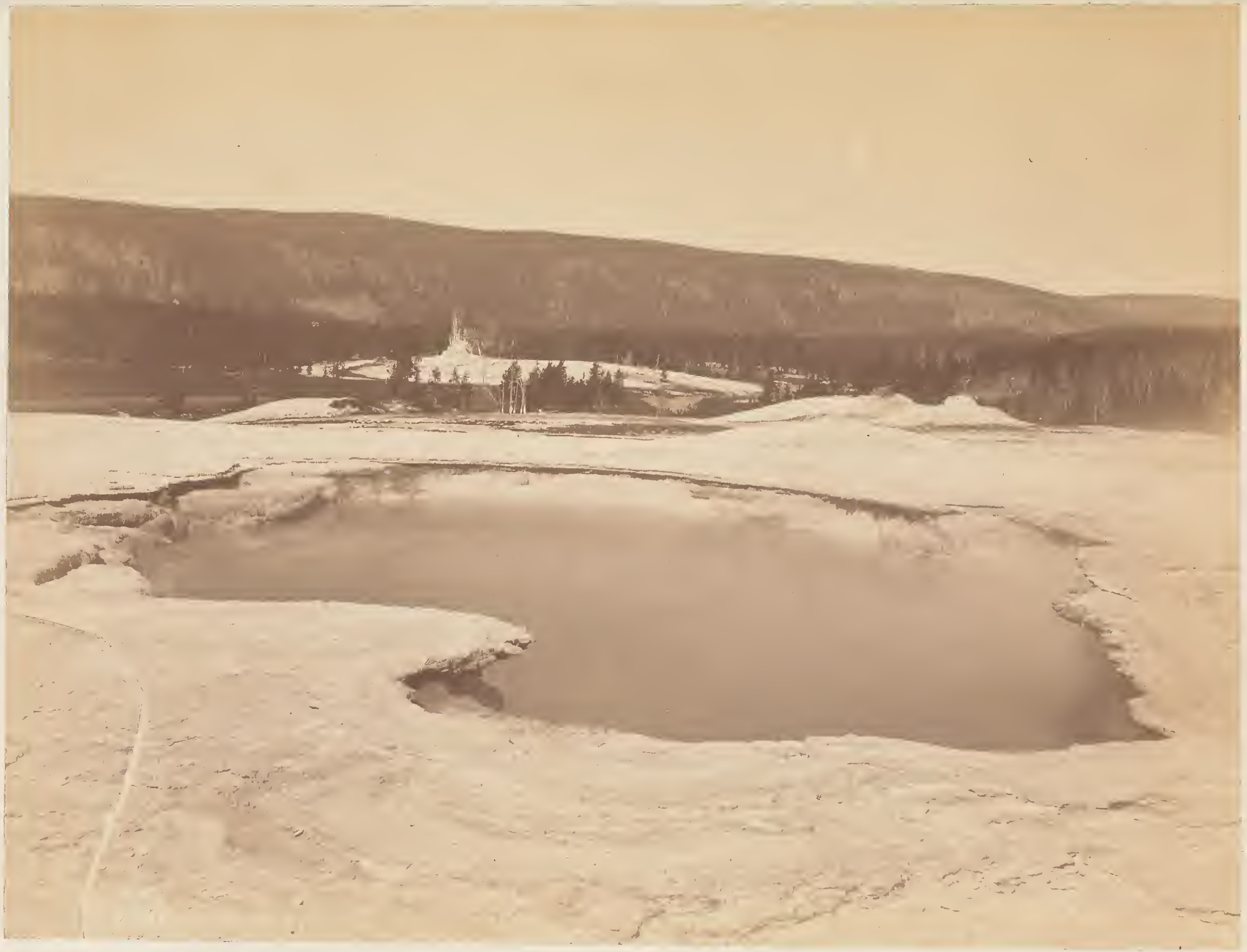


A great mud geyser — always bubbling. Sketch by W.H.H., 1872

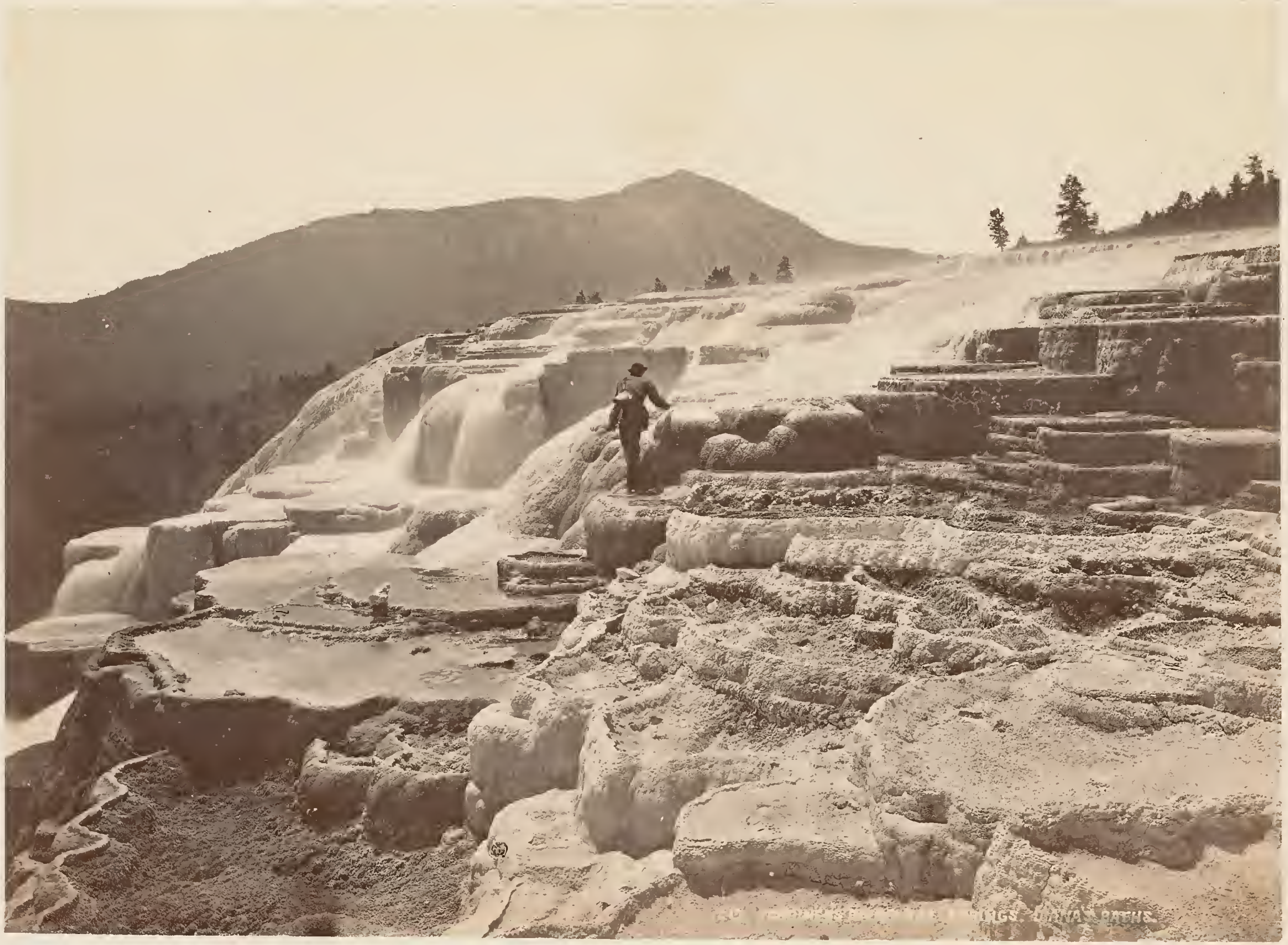


BOILING SULPHER SPRING.

a Typical boiling spring, rich in sulphur, 1872

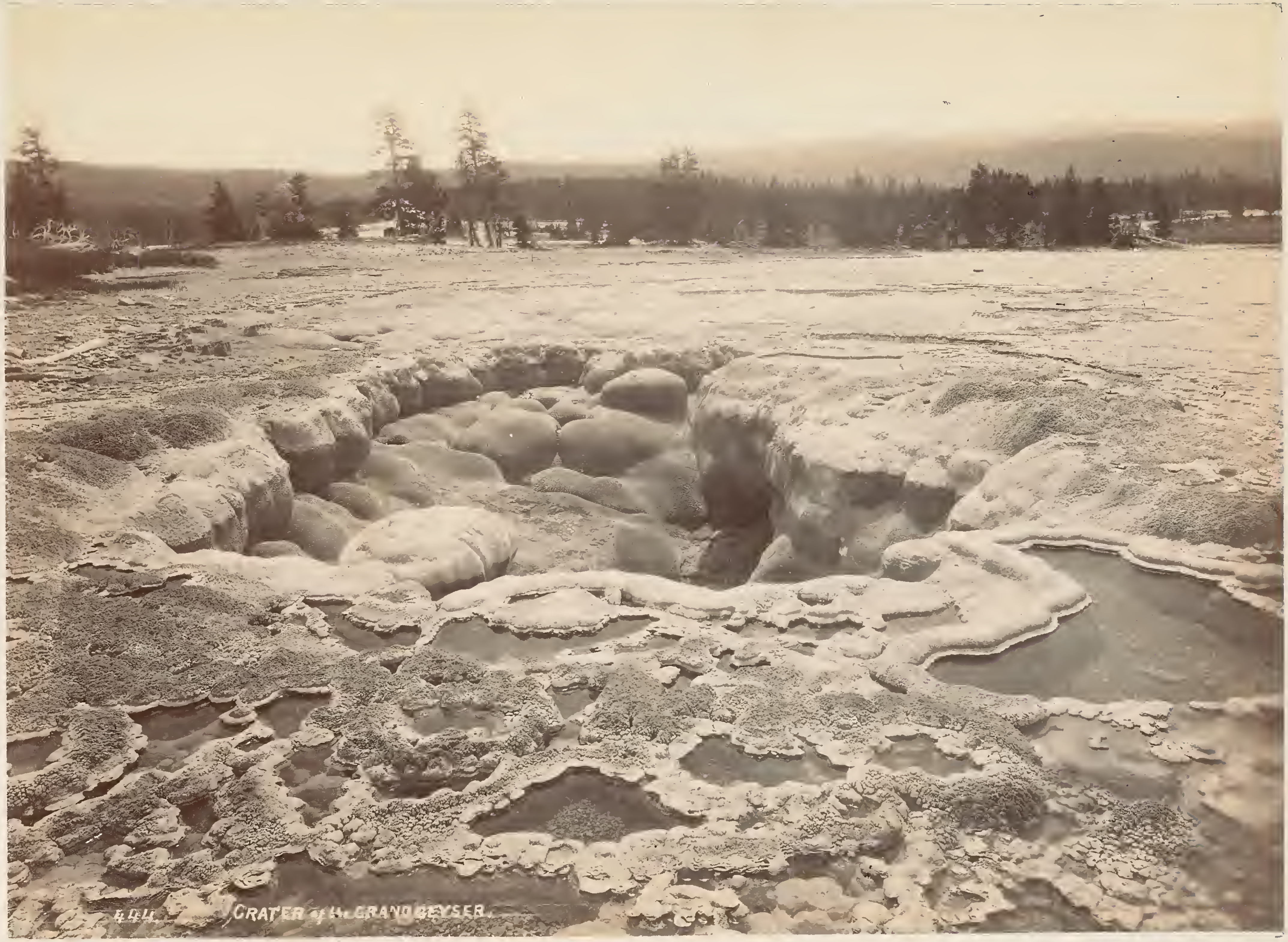


The Giantess Geyser at rest. Castle Geyser in distance

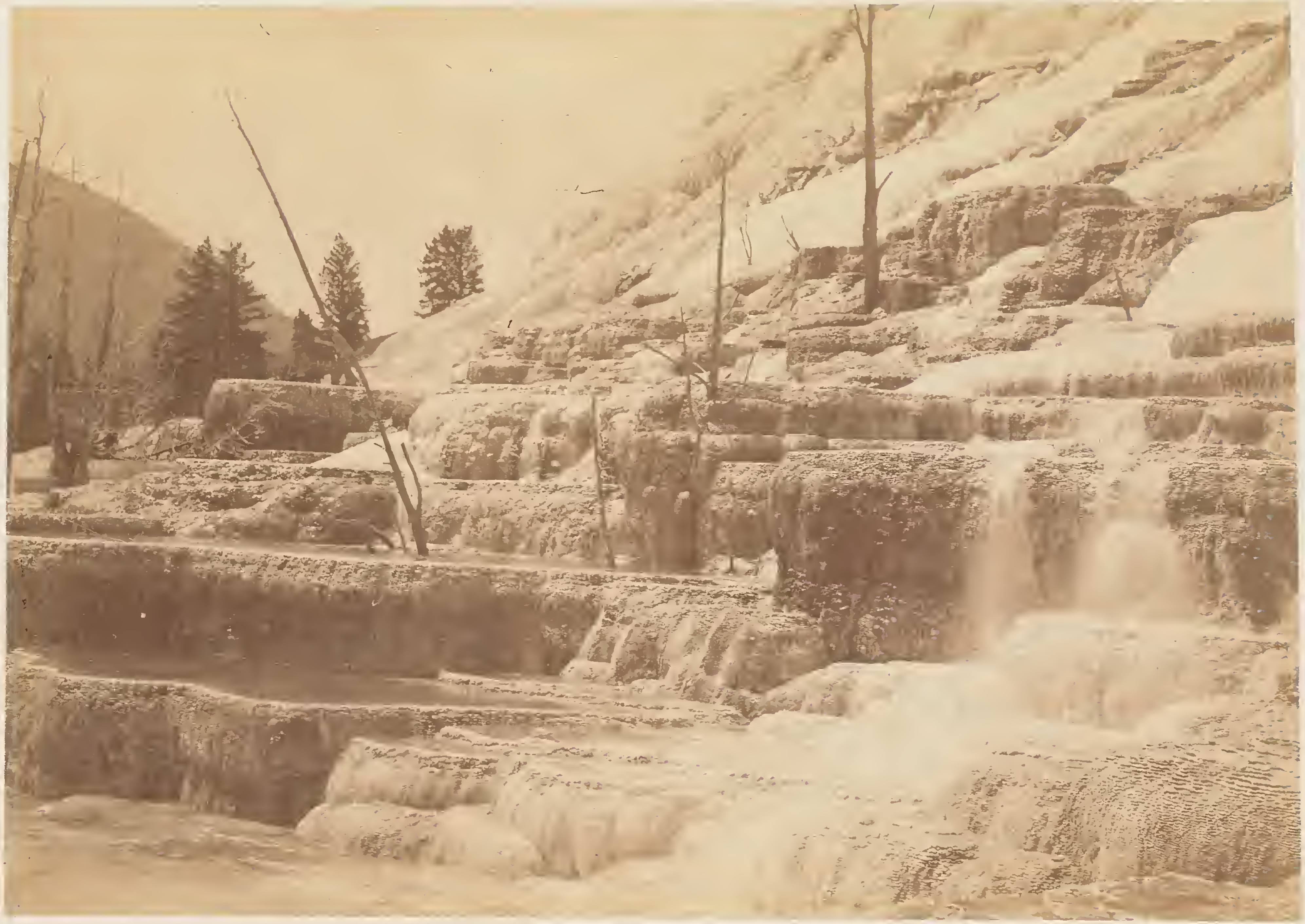


Gardners River Hot-Springs, wonderful terraced deposits, spring above,

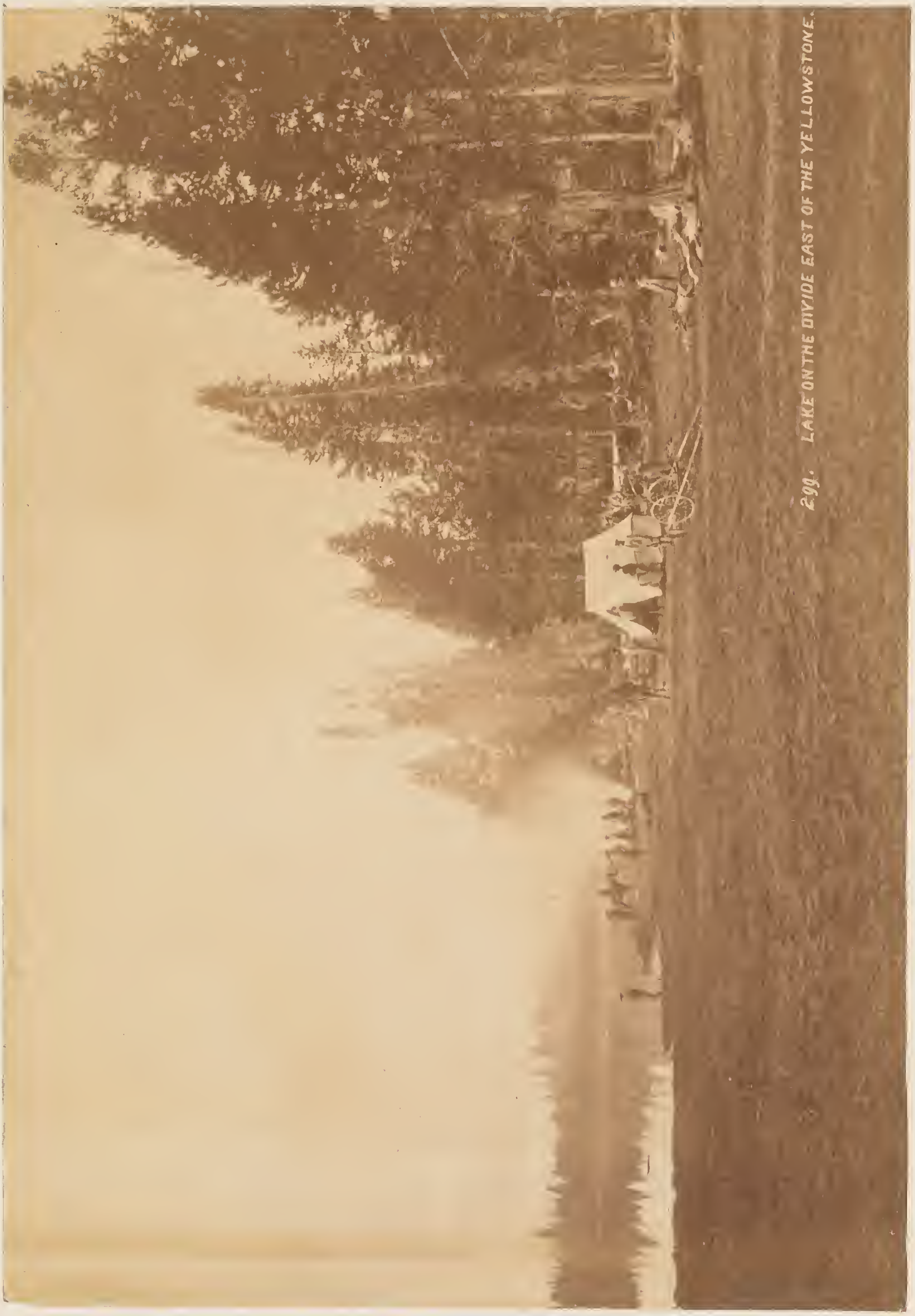
The figure is Thomas Moran, the artist - 1872


444. CRATER of the GRAND GEYSER.

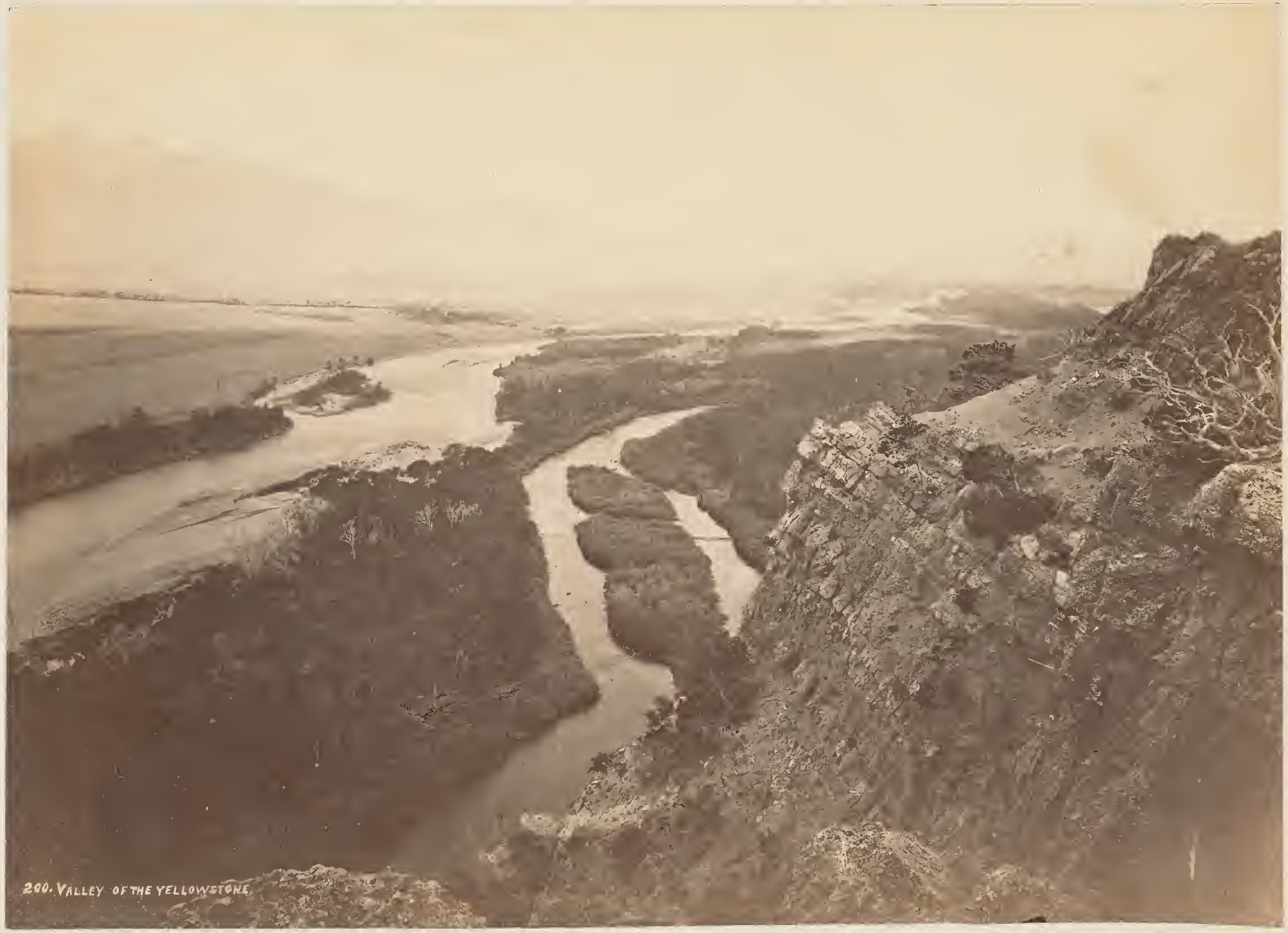
Crater of the Grand Geyser with wonderful deposits, 1872



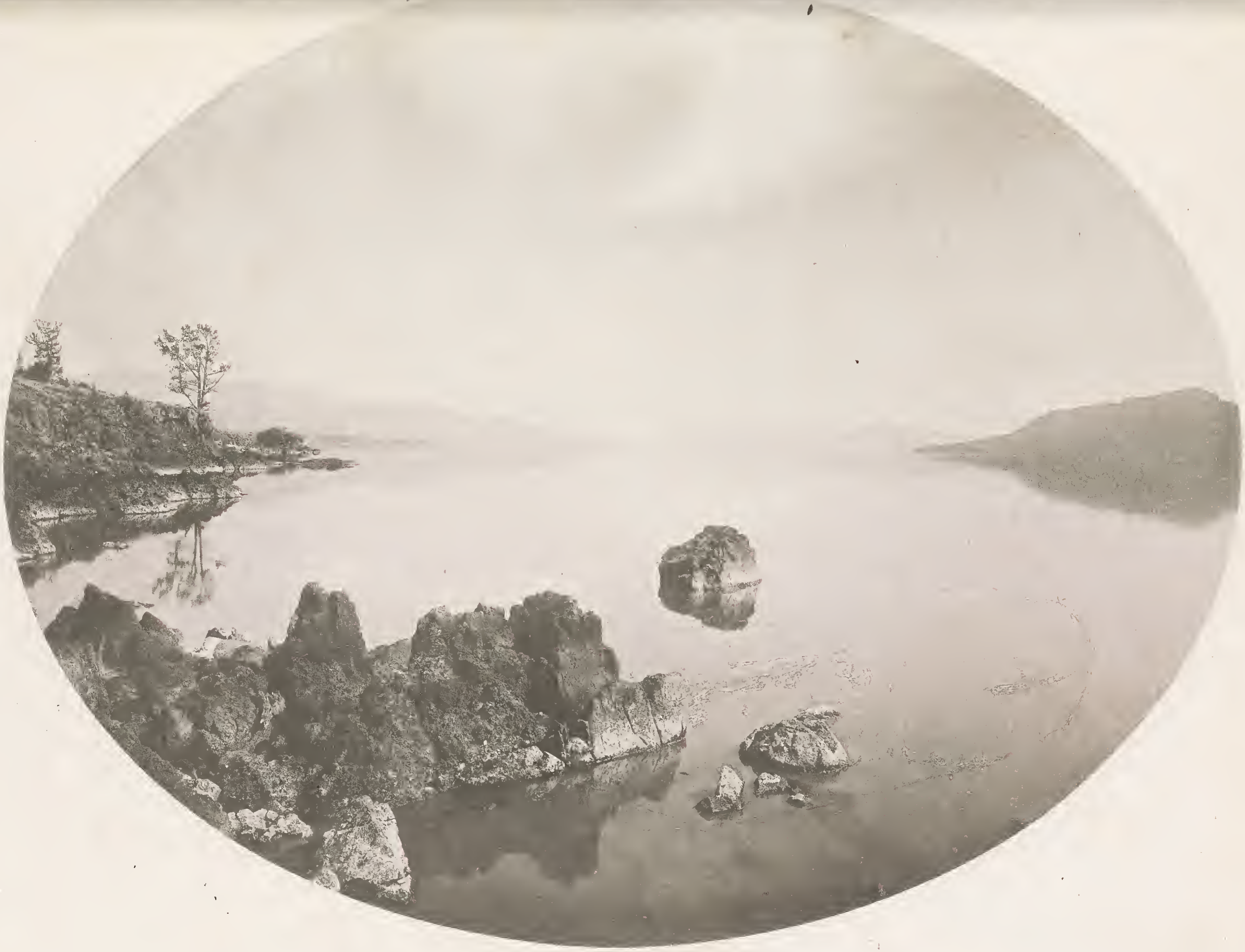
Mammoth [illegible]



299. LAKE ON THE DIVIDE EAST OF THE YELLOWSTONE.



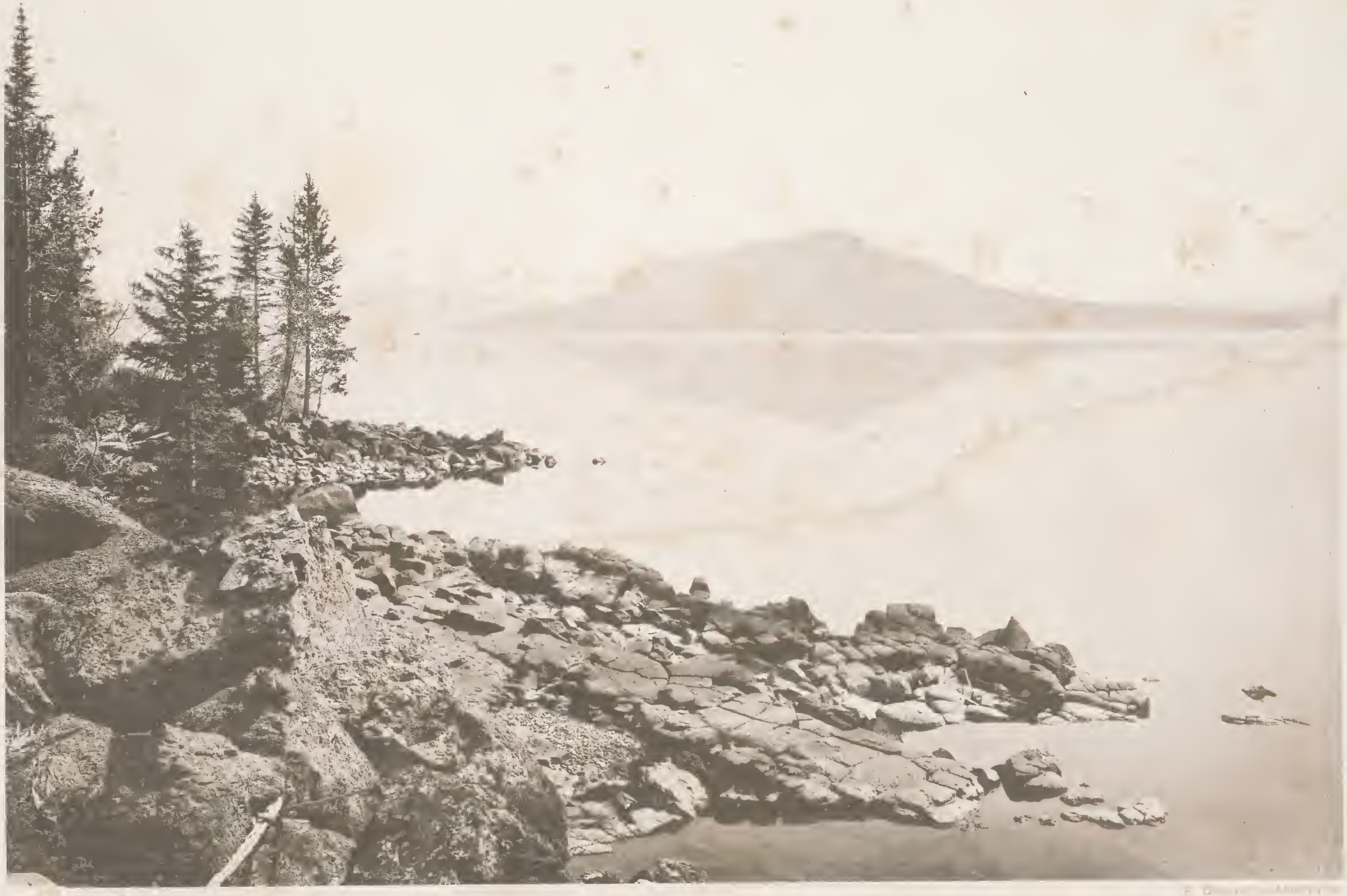
200. VALLEY OF THE YELLOWSTONE.



W. H. Jackson, Photo

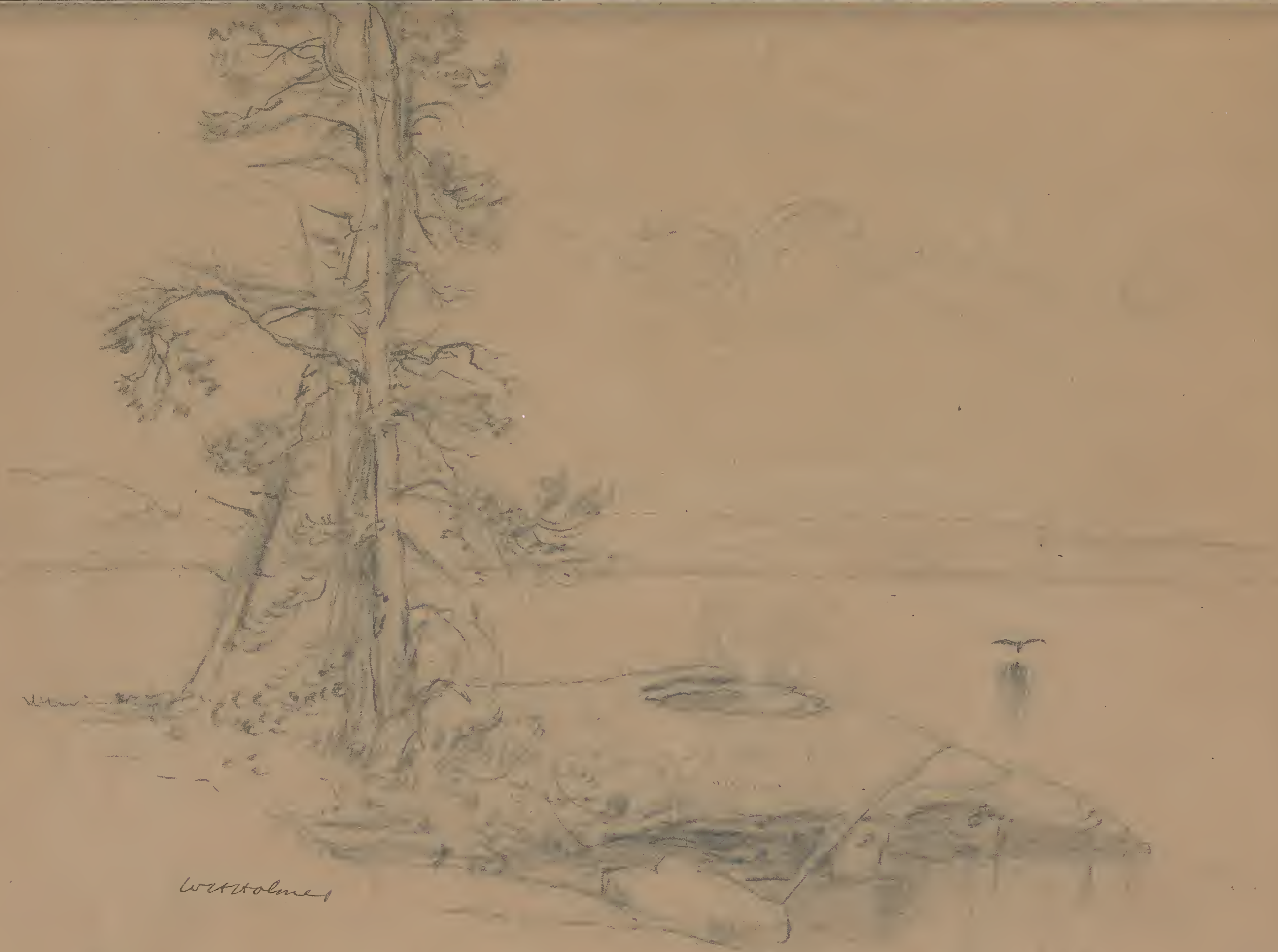
E. Bierstadt's Albertype.

YELLOWSTONE LAKE.
SOUTH-EAST ARM.



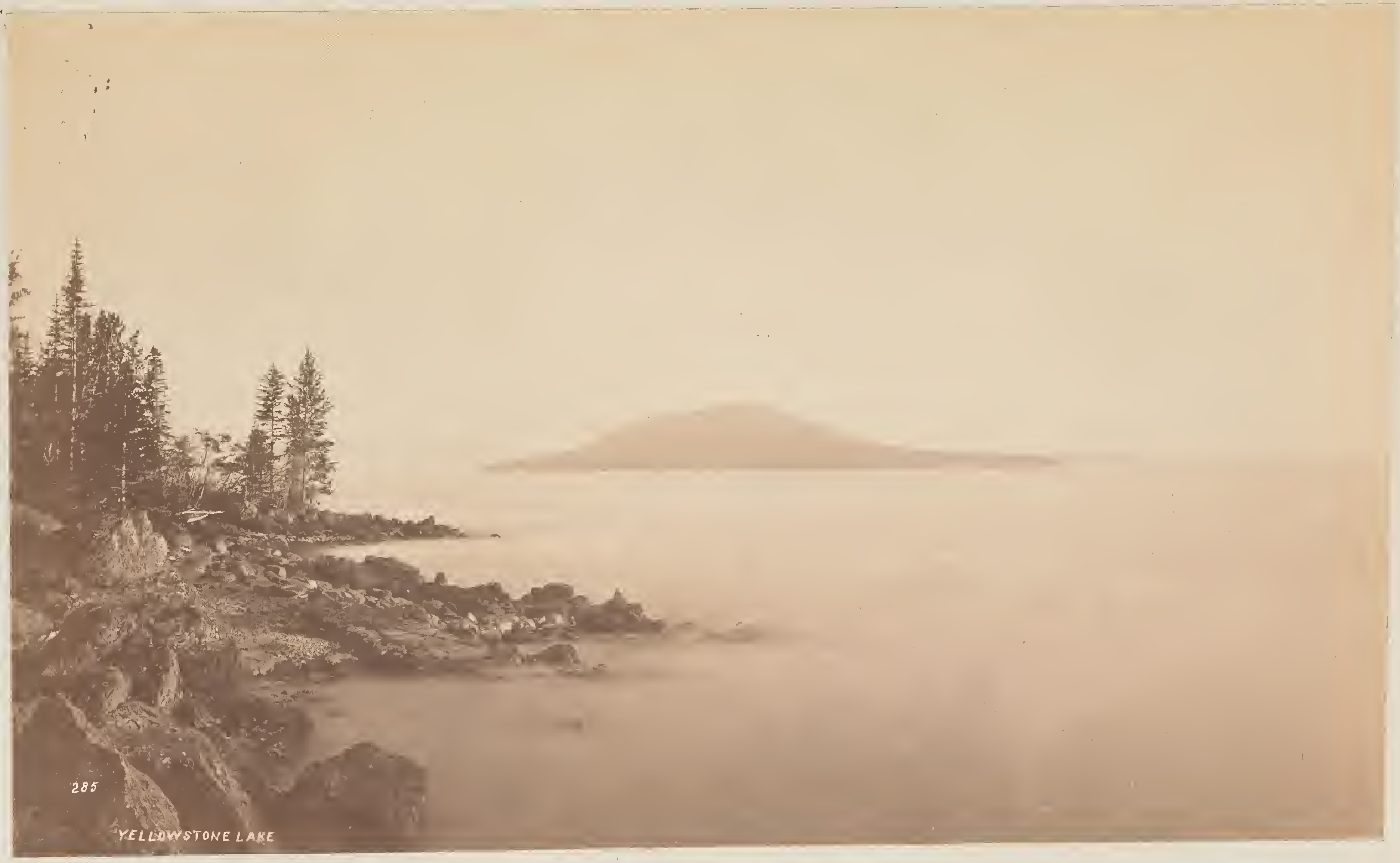
Promontory point

[illegible]



WHHolmes

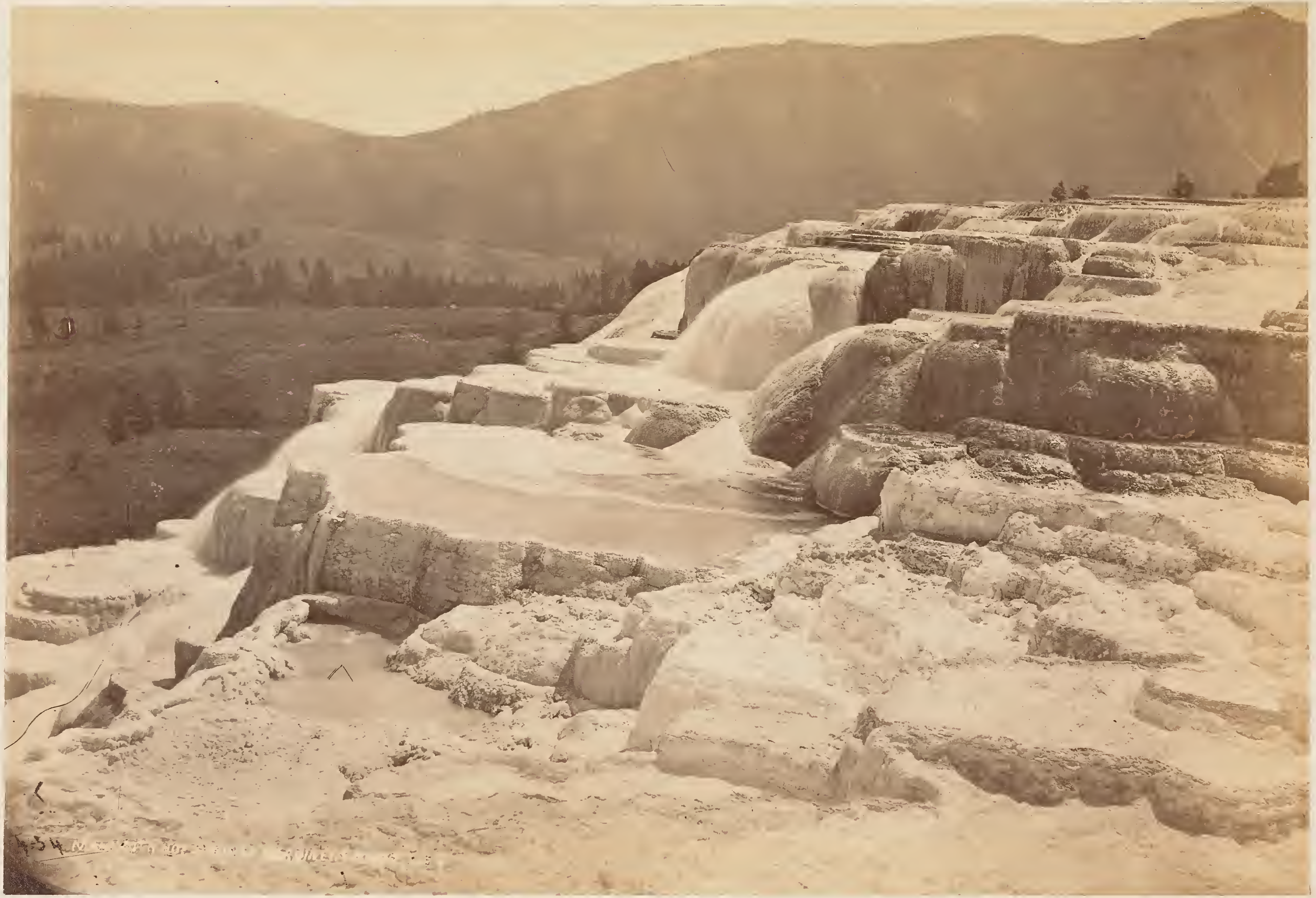
Hot spring on the lake shore where we caught fish from the lake, turned around and cooked them on the hook



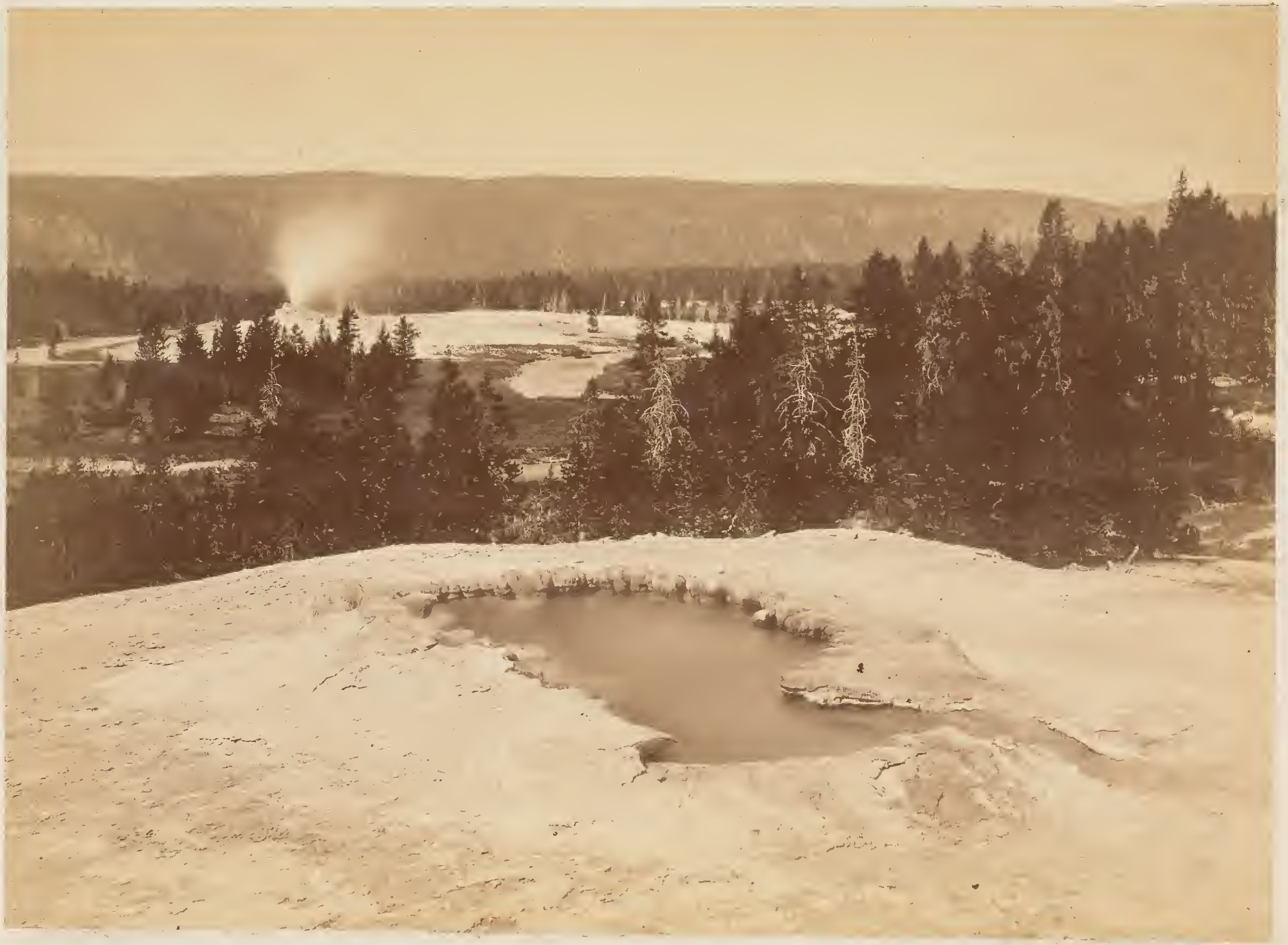
285

YELLOWSTONE LAKE

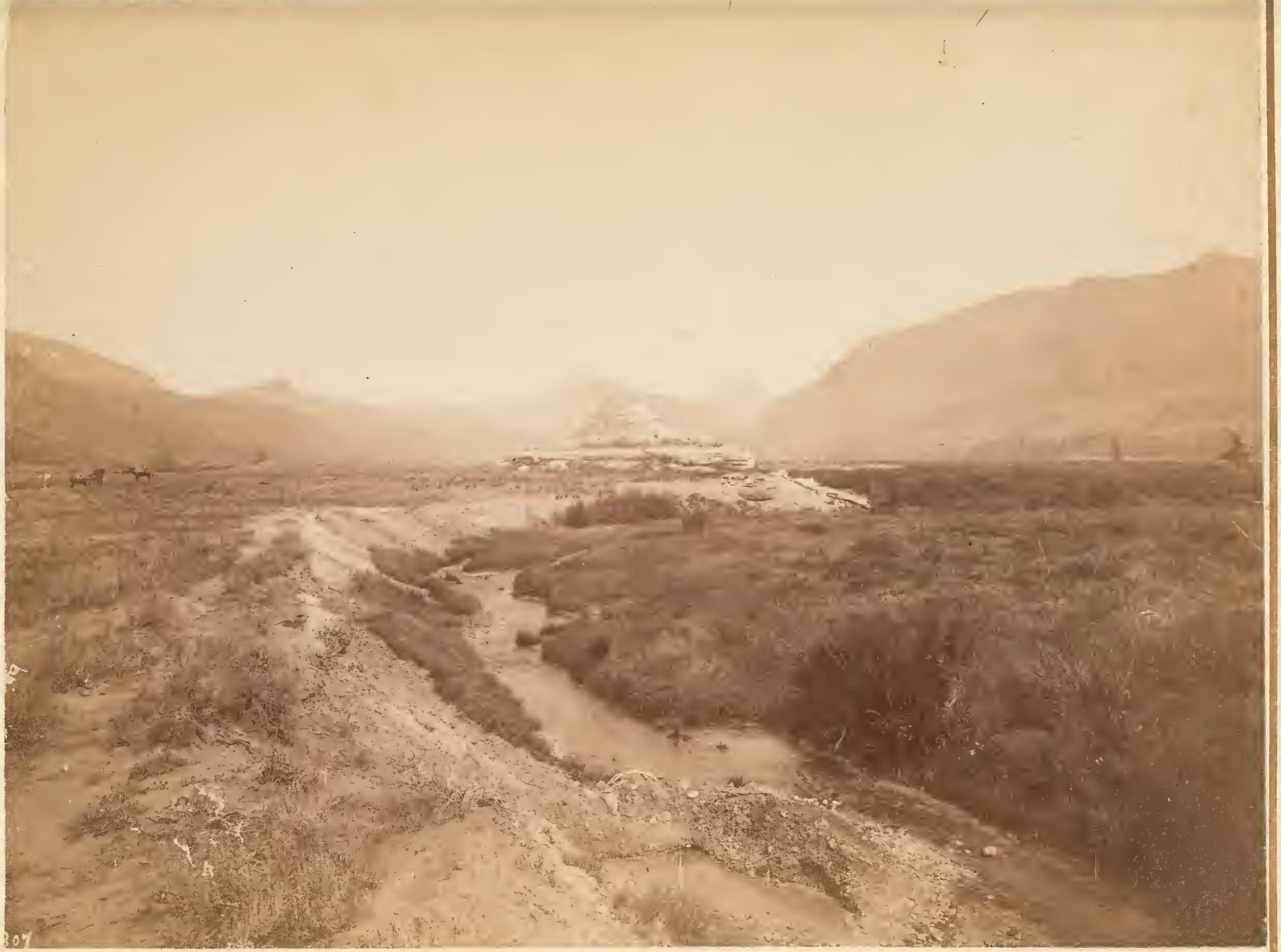
Jacksonia



A second view of the Gardiner hot spring terraces, called the Mammoth springs



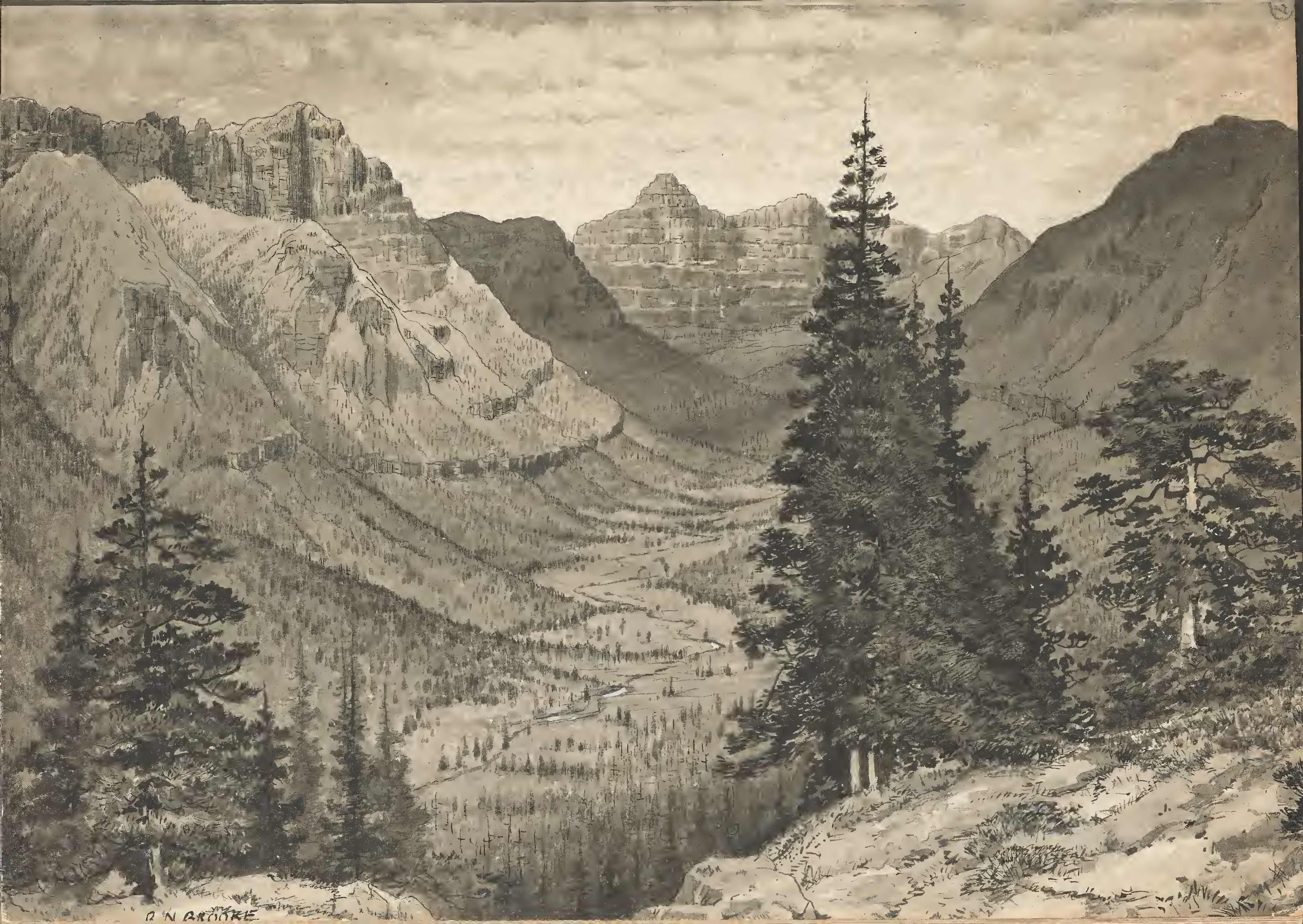
Hot spring with Castle geyser in the distance. 1872



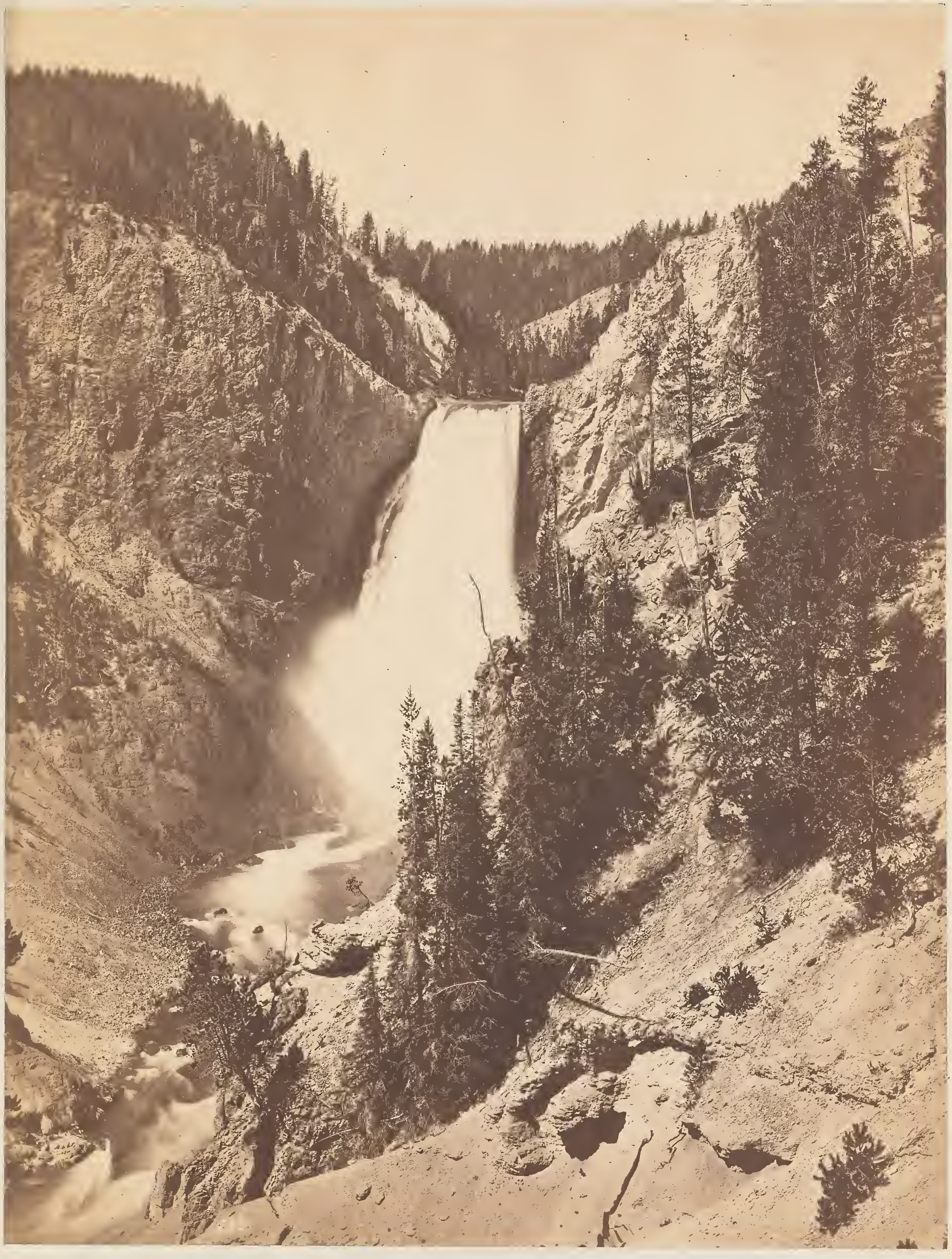
W. H. JACKSON, PHOTO. WASHINGTON, D. C.

Extinct hot spring cone, East Fork of the Yellowstone, 1872

EXTINCT HOT SPRING


R N BROOKE

Drawing by Richard Bornton
of the volcanic formation of the
East fork of the Yellowstone
From sketches by W H Holmes. 1872

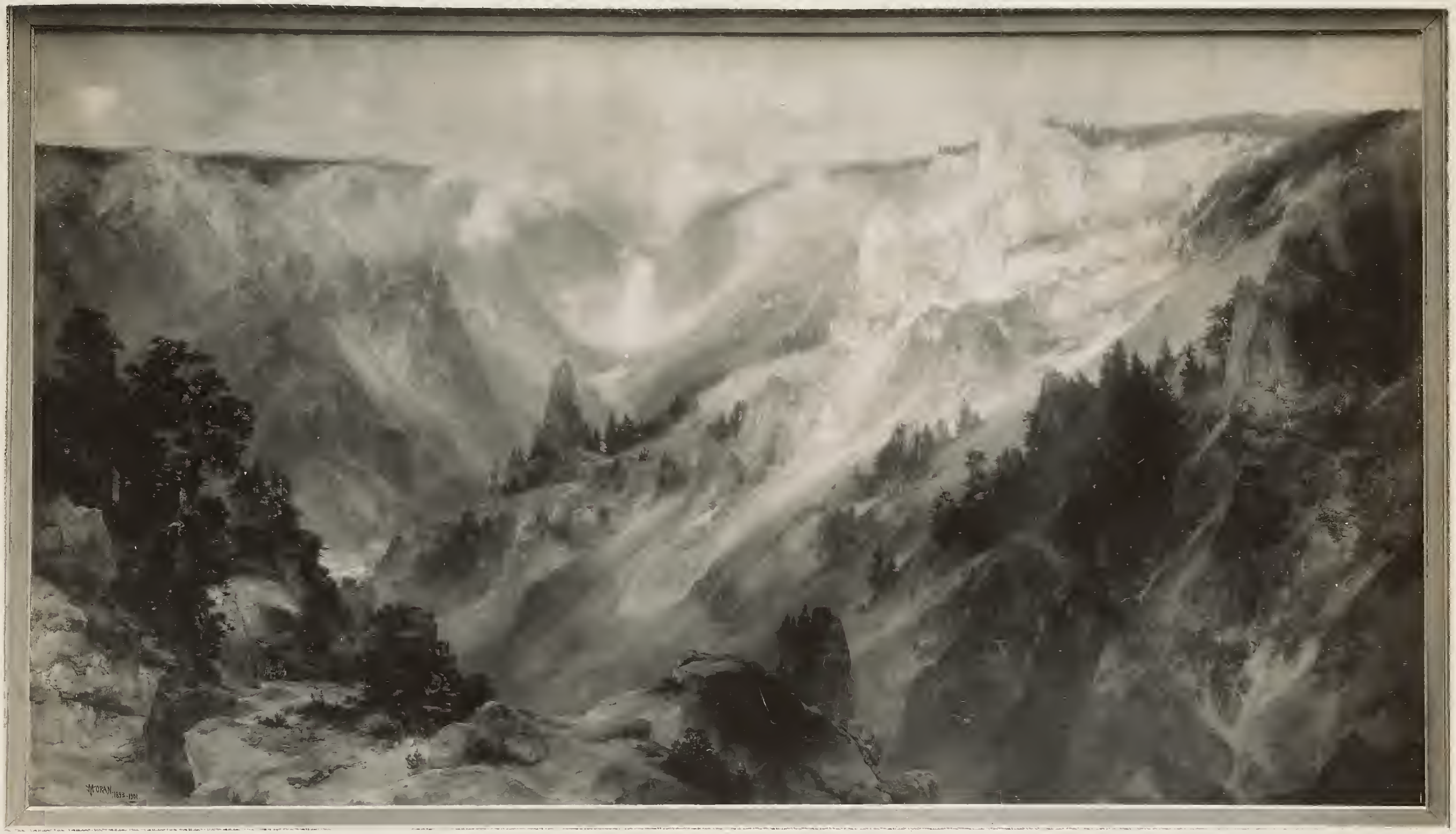


Upper falls, Yellowstone River, 1872

COLOR OF GREAT FALLS

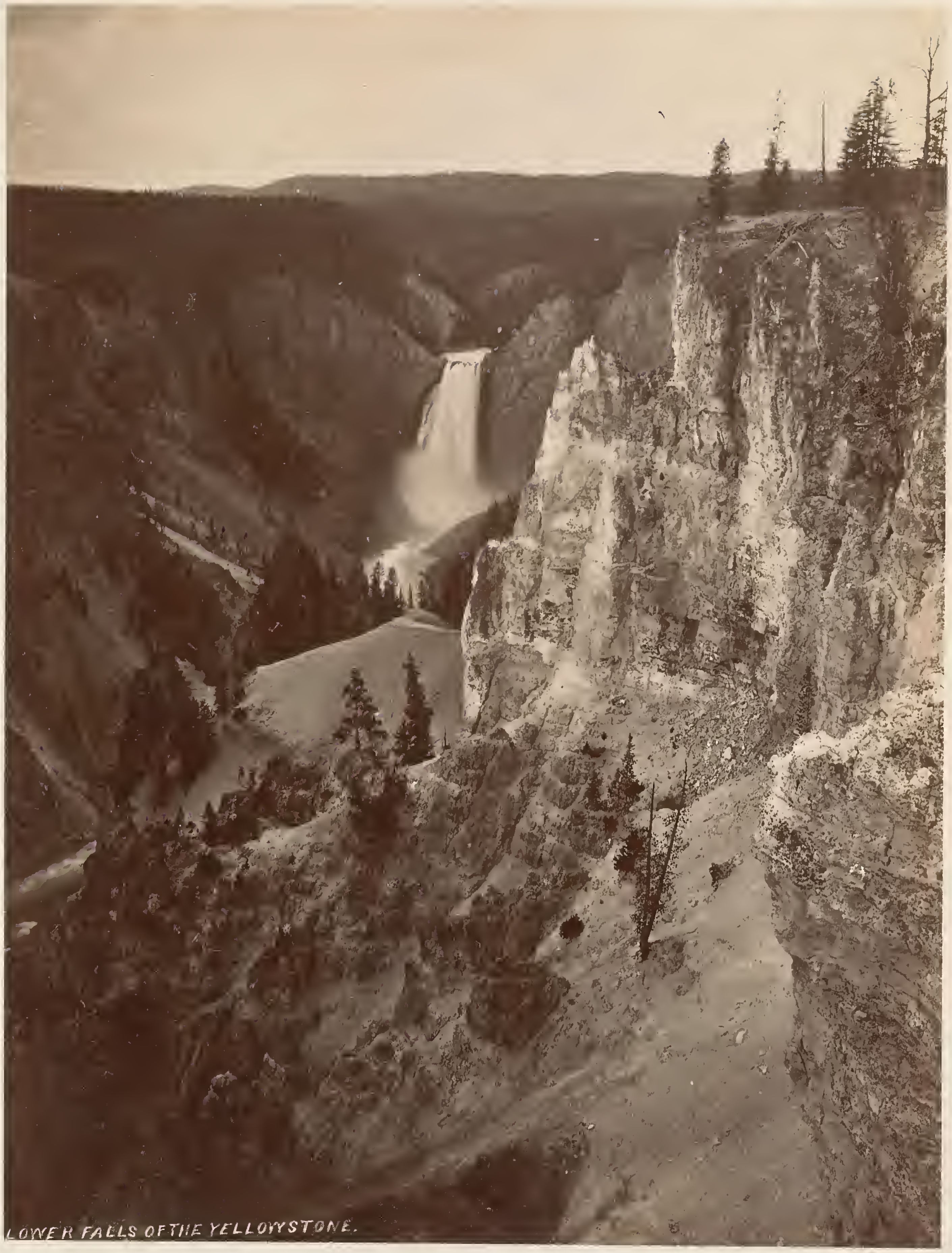
upper falls

Beautiful festoons shimmer down the sides almost white (foam in shadow). The smoother bellied parts of sheets a tender lilac festooned with white. Between swelling parts green festooned, all colors growing more lilac and gray as they descend. Shadows on mist at base quite dark; that in sun white and exceedingly airy. Mist heavier in body, lilac on edges. At bottom blending with white water which in the sun is ruch and creamy with intercolated portions of greenish. Darker part rich brown green. Showers of water at left white and dark gray under;rock that is wet is very dark. Rocks in foreground may be of any form and any color; often spotted where the mist in shadow passes behind the dark rock in front it becomes quite blue. Festoons of water fine and woolly near brink. Large and stringy farther down at the edges becoming detached looking like irregular comets. Moss on rocks where spray falls. A tree with reflection on trunk and red and yellow leaves. A thing of infinite beauty.

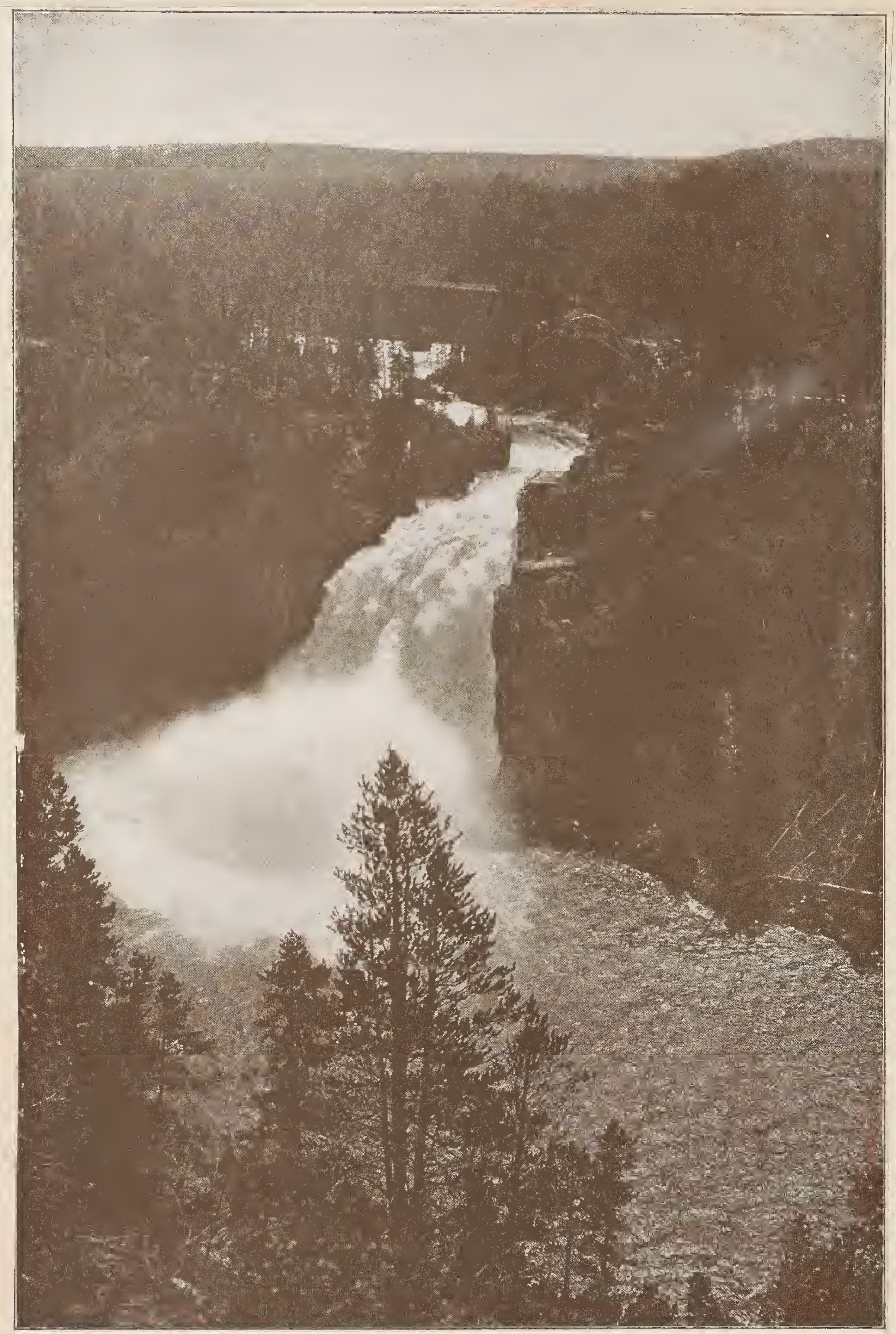

TMORAN 1893-1901

The greatest landscape ever painted
by Thomas Moran, presented to the
national gallery by [illegible]
1928

See page 187



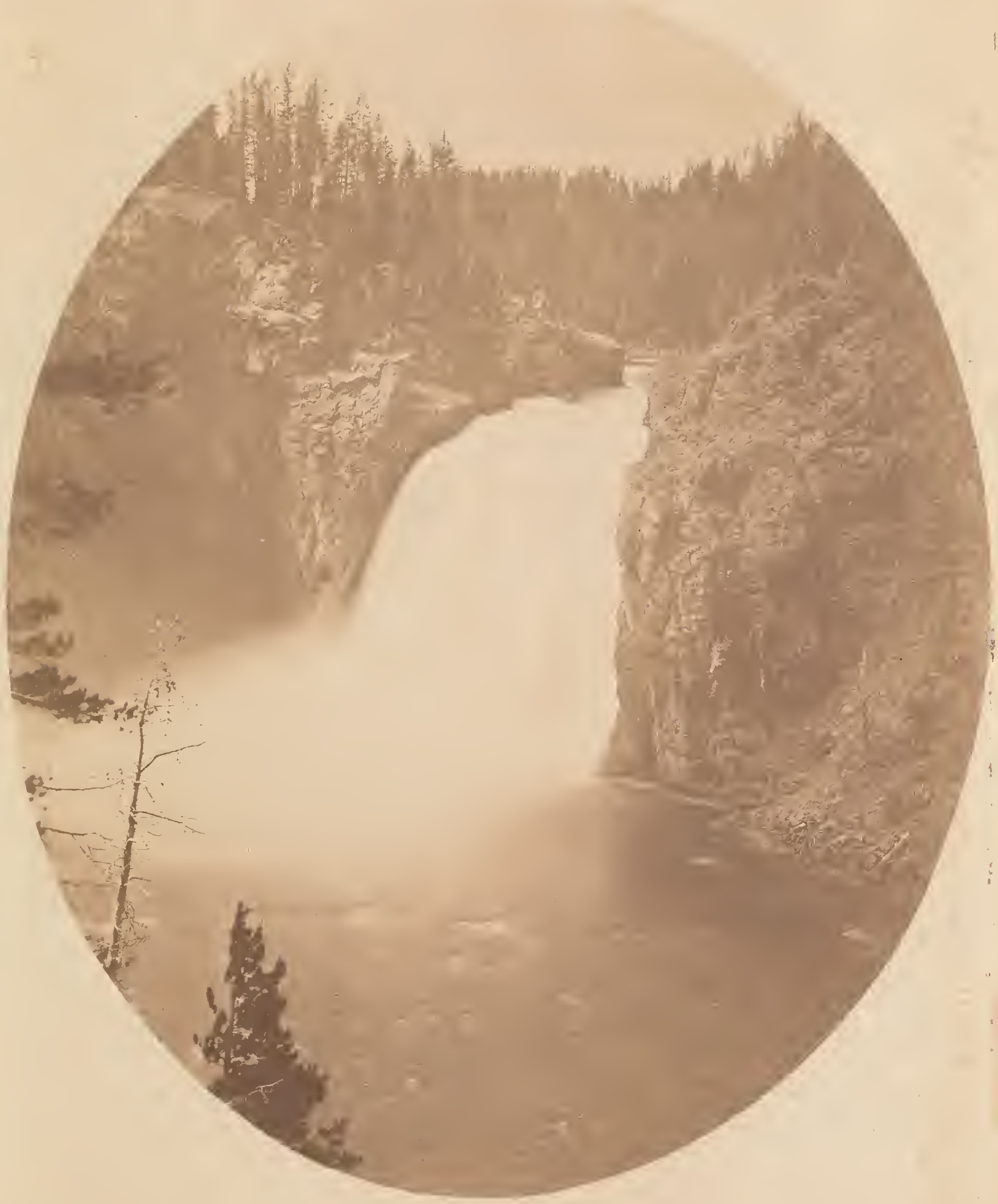
LOWER FALLS OF THE YELLOWSTONE.



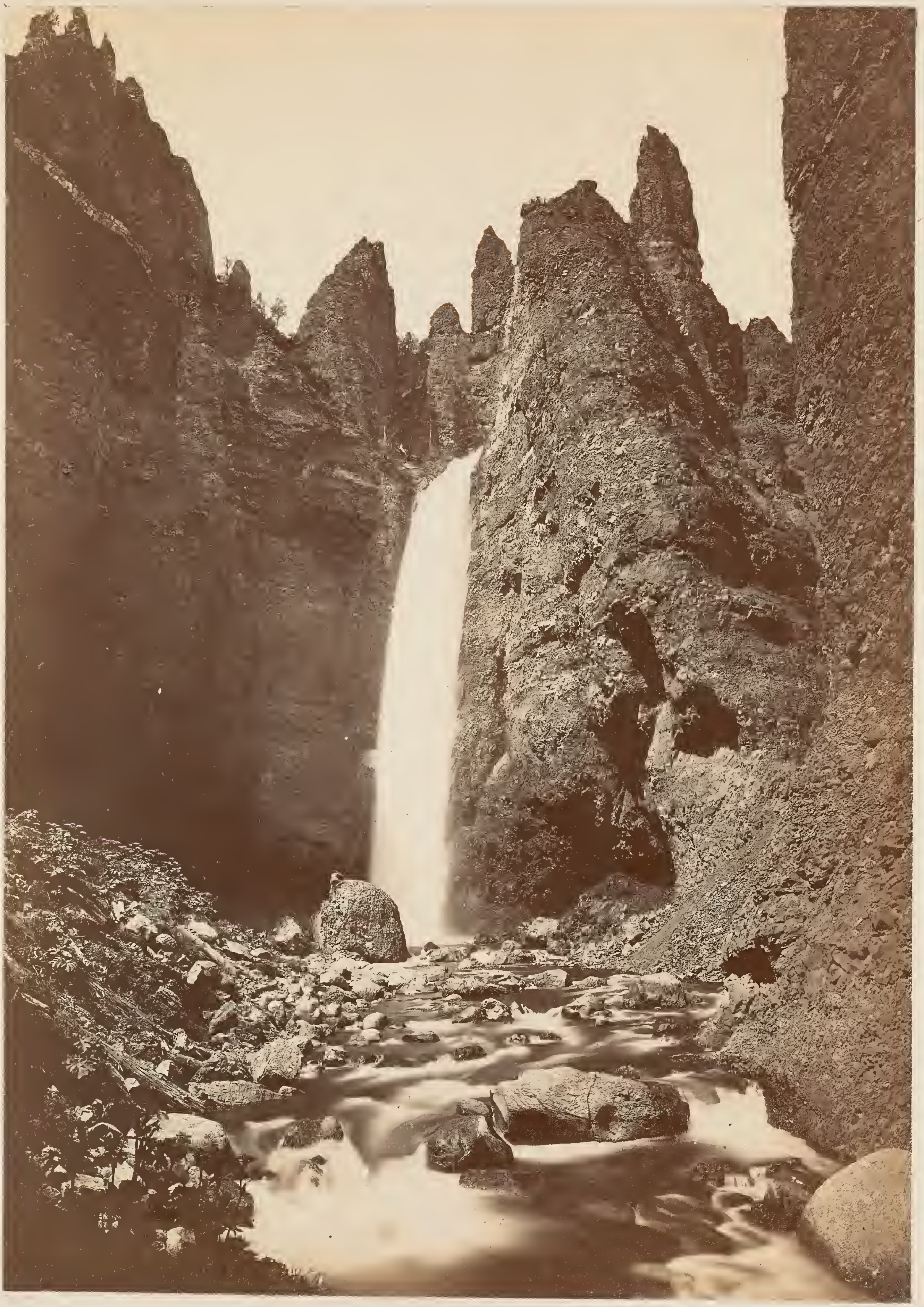
Photograph by George R. King

THE UPPER FALLS OF THE YELLOWSTONE, A FEW MILES BELOW YELLOWSTONE LAKE

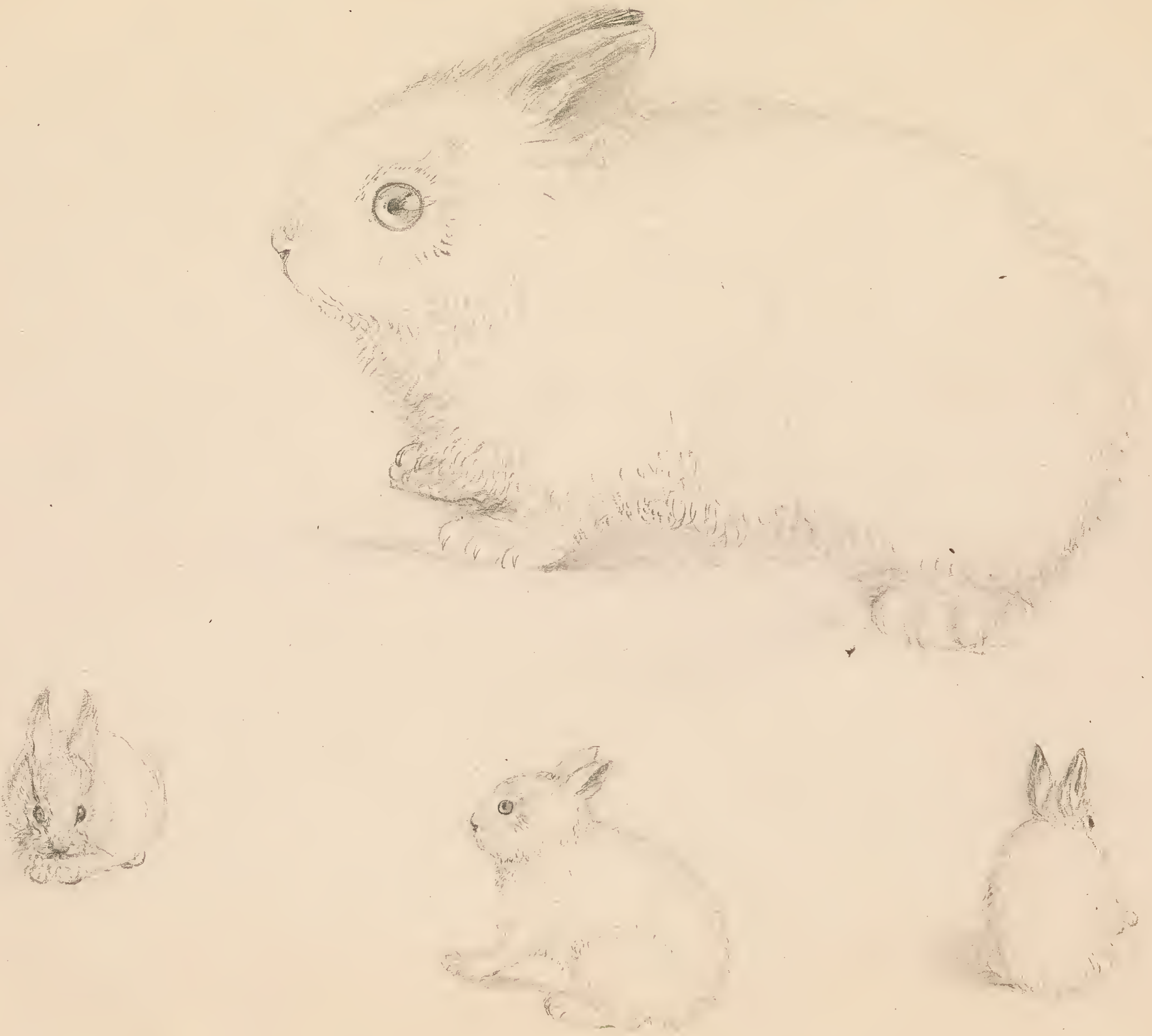
Above these falls the rushing river lies nearly level with surrounding country; below it begin the canyons



Upper Falls

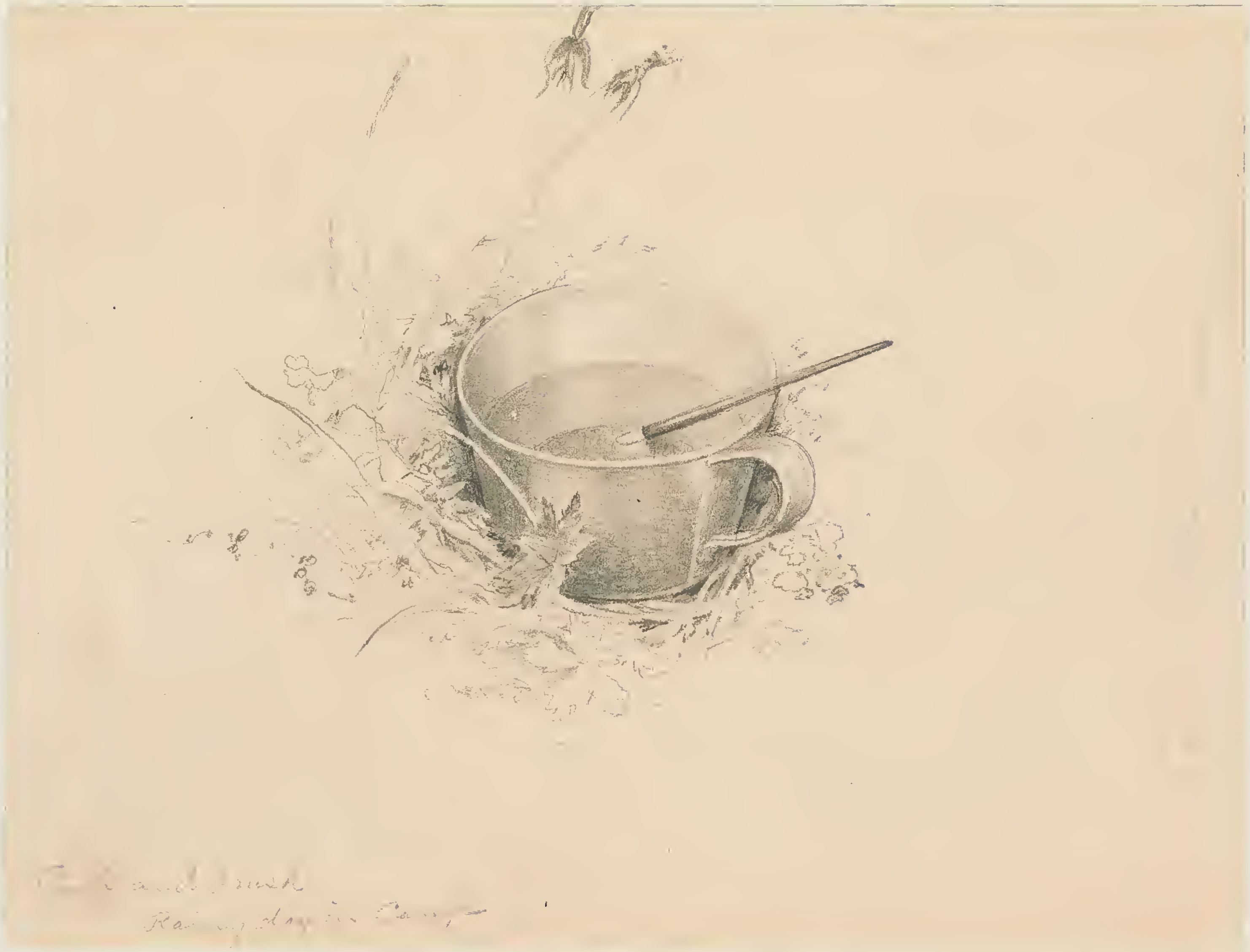


Lower Falls



WM

The charming little 'Snow rabbits' which inhabit the Johnstone [illegible]


Cup and brush
Rainy day in Camp

An idle hour

Photograph by J. E. Haynes, St. Paul

THE GIANT GEYSER, IN MANY RESPECTS THE GREATEST OF ALL

It spouts for an hour at a time, the water reaching a height of 250 feet. Interval, six to fourteen days

RANDOM RECORDS OF A LIFETIME
DEVOTED TO SCIENCE AND ART, 1846-1929-31

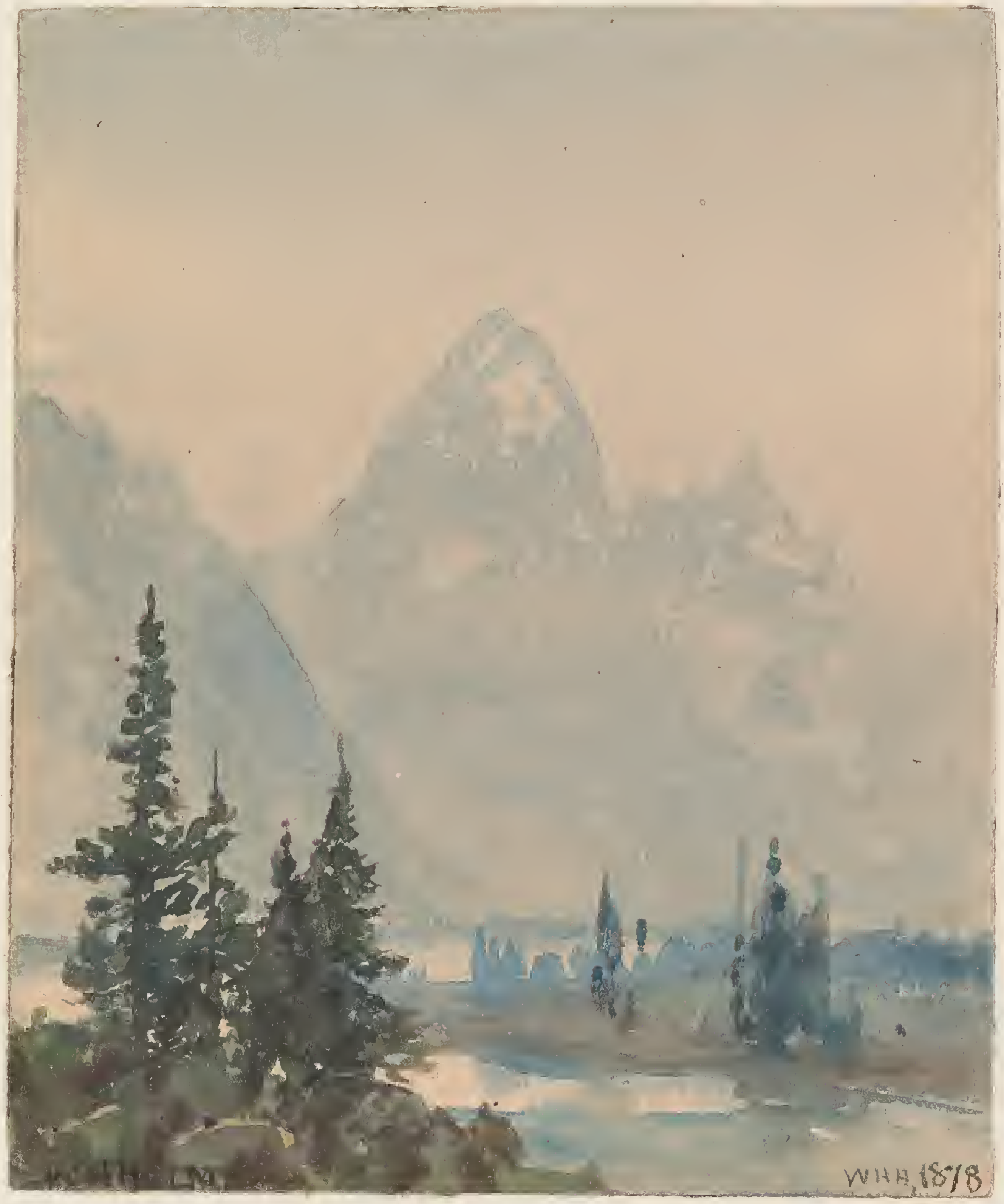
VOLUME III

SURVEY OF THE YELLOWSTONE, PART II, 1878.

W. H. HOLMES GEOLOGIST ON THE SURVEY.

PART II.

Introductory.
Trip West to Cheyenne, Wyoming, July 21.
March from Davis Ranch to the Yellowstone.
Total Eclipse of the Sun, July 29.
Wind River Peak Climbed.
Ascent of Fremont's Peak.
Reached Green River.
Reached Snake River.
Sketched Magnificent Teton Range.
Shoshone Lake and Mount Sheridan.
Upper Geyser Basin.
Yellowstone Lake.
The Geysers' Action and Deposits.
Ascent of Mount Sheridan.
The Elk Chase and the Antlers.
Shoshone Lake.
Eruption of Old Faithful Geyser.
Other Wonderful Geysers.
Meeting Colonel Morris, Supt. of the Park.
Eruption of Fountain Geyser.
Indian Scare. (p. 34)
Lower Geyser Basin.
Yellowstone River and Canyon.
Upper and Lower Falls.
Measured the Height of the Falls.
Professors Field and Jones in 1928, find my interpretation of the Canyon Geology O. K.



The Grand Teton

EXPLORATION OF THE YELLOWSTONE NATIONAL PARK BY THE U. S. GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, 1878.

DIARY OF W. H. HOLMES, GEOLOGIST.

The entire year 1877 and the first six months of '78 were devoted largely to the completion for publication and record of the work of the proceeding field seasons in Colorado. My life in Washington at this period, full of interest scientifically and artistically and seasoned with many trivialities, is recorded in the accompanying diary, fragments of which may be of interest to me and my friends in years to come. Among the features of the spring season was a two weeks visit to Avoca, North Carolina, where I enjoyed the hospitality of the U. S. Fish Commission, my old friend James W. Milner in charge, and carried on archeological studies on neighboring sites of Indian occupation.

On the first day of July 1878, I set out to join our field party at Cheyenne, Wyoming, (see diary) bound for the Yellowstone Park, which region I had visited as artist of the Survey in 1872. The present year as Geologist ~~to~~ on the Survey, I was associated closely with Dr. Hayden, Director of the Survey, during a large part of the season's operations.

A feature of the year's work of particular interest to me personally was the naming by Chief Topographer Henry Gannett, with the approval of Dr. Hayden, of a prominent mountain of the Gallatin Range, Mount Holmes, which will serve to perpetuate a

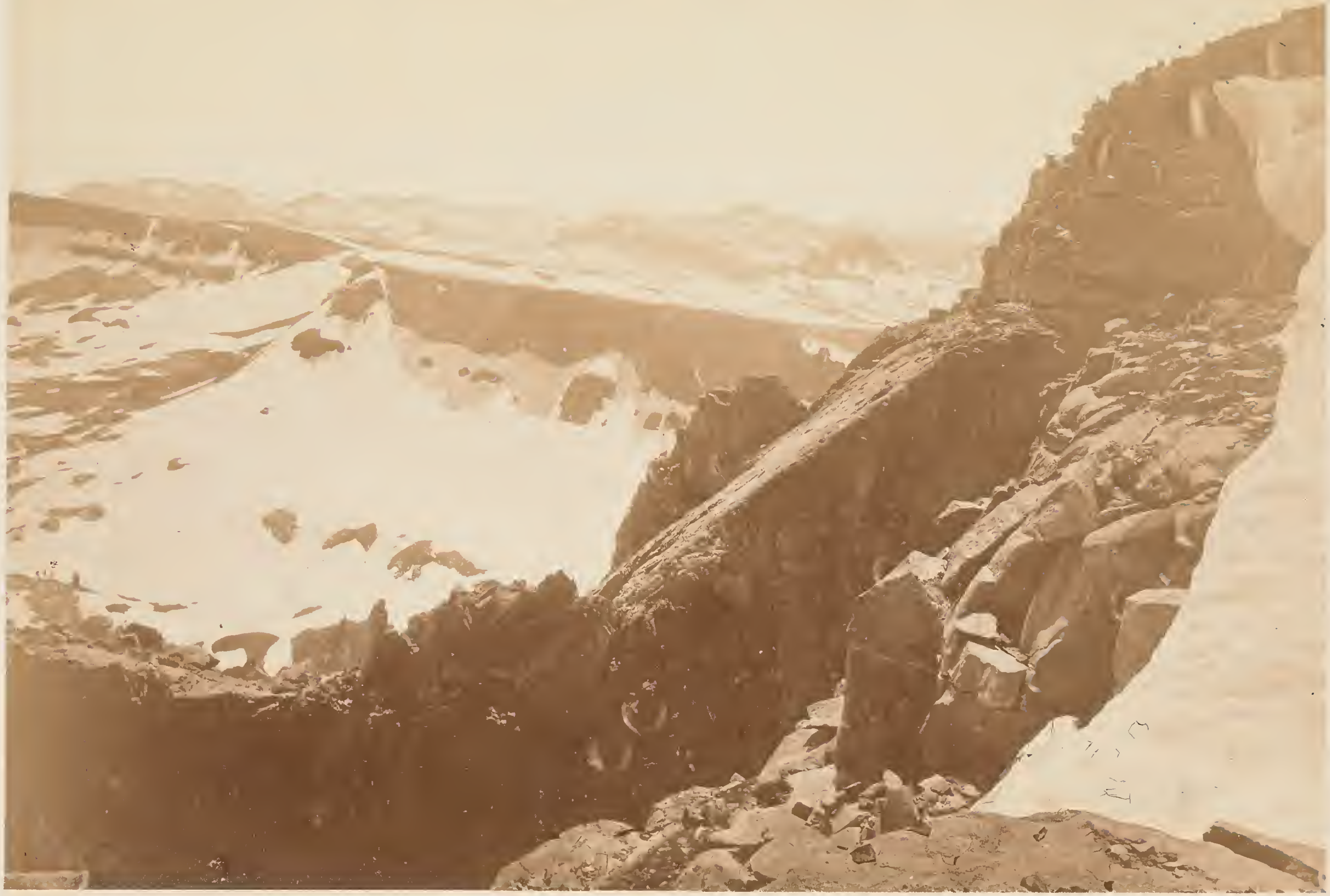
get photo

[illegible]

knowledge of my connection with the Survey. This mountain is in plain sight from the geyser basin and is 10,300 feet in height. (See accompanying photograph and the pencil drawing by W. H. Jackson in my 80th Anniversary Letter Book in the National Gallery library. See also map and panoramic views contained in the 1878 report of the Survey). Another honor, which ordinarily escapes attention is the naming after me of a fossil shell, Unio Holmesianus by Professor White, Paleontologist of the Survey.

The narrative of the season's operations, full of interest to every one concerned, is best recorded in my diary, a copy of which follows. Associated with this day by day story are copies of my geological report as printed in the Survey Annual for this year. Separate accounts are given of my observations on the glacial phenomina of the Park, the fossil forrests of the Park and the Indian implements of obsidian distributed widely over the whole region.

My original field notes in the form of a diary, were too voluminous to be preserved and have been destroyed. The larger sketch books filled with panoramic and other views and drawings have been retained with the records of the Survey. A copy of my diary for the season is contained in a separate envelope and a duplicate copy has been sent to Mr. Albright, Superintendent of the Park. 1926,



In the Teton Range

1 & 2 Book

The geological work was under the charge of W. H. Holmes, A. C. Peale, and Orestes St. John, and the paleontological work under Dr. C. A. White. Mr. Holmes made a general survey of the park, while Peale, assisted by J. E. Mushback, was occupied in making detail studies of the geyser and hot-spring localities."
(Page 603)

o-o-o-o-o-o-o-o-o-o

"The two volumes mentioned are almost monographic as far as the hot springs and geysers are concerned, and are rendered unusually attractive for their time by the sketches and panoramas of Holmes. Peale gave a detailed description of all the springs and geysers of any importance found in the park, describing and tabulating over 2,000 of the former and 71 of the geysers. Holmes's report was accompanied by some brief petrographic descriptions by Capt. C. E. Dutton."
(Page 603.)

Complete this section
to add to the 1878
also [illegible]
Get Jackson's portrait —
mention the [illegible]
and east [illegible]

U. S. GEOLOGICAL SURVEY EXPEDITION
TO THE YELLOWSTONE PARK, 1878.

Diary for 1878, Copy of Notebooks

July 21. In camp, Davis Ranch near Cheyenne.

July 22. " " " " " "

July 23. March with pack train from Davis Ranch to Cheyenne.

July 24. Leave Cheyenne at 2 o'clock.

July 25. Arrive at Point of Rocks.

July 26. From Point of Rocks to Leucite Butte.

July 27. From Leucite Butte to North Pilot Butte.

July 28. Sunday. From North Pilot Butte to the second bend of the Sandy Creek.

July 29. Eclipse today. March down Sandy Creek 5 miles. Camp made at noon. Observe eclipse and make various records, also sketches of the eclipse corona.

July 30. Make a long march 25 miles to the base of Wind River Mountains near head of Sweetwater River. Cross stage road at station and send letters home.

The geology from Point of Rocks to this point is very simple. We pass up through the upper Laramie beds and in North Pilot Butte and reach the Green River. From this Butte to the Granite and west base of Wind River Mountains there is nothing but Green River and Wahsatch

The tertiary rocks, probably both of the above groups, rise ~~lie~~ slightly within 5 miles of Granite and afterwards fall and jet almost horizontally against it. (see sketch book No. 1).

July 31. March from camp on Landers Creek to a branch of Sweetwater 10 miles further on, reaching the border of the timber. The granite outcrops at at camp but much of the space between this and the previous camp is covered with drift and terraced. In the after oon a side trip party marched up the Sweetwater moraines 5 miles to the pass, thence down a branch of Popojean Creek and up another branch to the base of Wind River Peak. All of the formations are granite.

Aug. 1. Ascended Wind River Peak and made a panoramic sketch. The ascent was moderately easy. Found a glacier near summit and evidence of ~~a~~ past glacial action is very striking and extensive. Flies are very bad. (See photos)

Aug. 2. Returned to main camp below.

Aug. 3. Marched to Big Sandy Creek, Landers Road Crossing.

Aug. 4. From Big Sandy Creek to New River at base of Granite Butte. Exposure of in Wahsatch group. Sketch of moraines.

Aug. 5. Marched from New Fork to the lakes, crossed a great moraine to a lovely lake. Jackson made views

and I made sketches. Passed over moraine to another creek and up a large butte around which a glacier has branched, passing beyond on the two sides. Camped at lower end of a large, fine lake.

Aug. 6. Marched up the lake shore along the moraines to the plateau and thence over the glaciated granite to within 5 miles of the base of Fremont's Peak.

Aug. 7. Ascended Fremont's Peak. A hard rocky ~~incline~~ climb of 6½ hours. The lakes, the polished rocks, the steep walls, the glaciers, the plateau all afforded fine effects. Descend to camp.

Aug. 8. Photograph range and return to main camp in afternoon.

Aug. 9. Camp remains on Long Lake and a small party of us go to Long Butte. Have an interesting day and return.

Aug. 10. Move from Long Lake to Green River.

Aug. 11. March from Green River across divide into Hoback Creek. The geological formations below first lake seem to be Wahsatch. There is a slight rise to the north and it seems probable that the Laramie comes up between Long Lake and Green River. At the divide between Hoback and Green River the Laramie appears in full force, dipping one or two

degrees down Green River. The members of our party at present are:

F. V. Hayden, Director of the Survey.
W. H. Holmes, Geologist.
A. D. Wilson, Topographer.
W. H. Jackson, Photographer.
E. Eckles, our English guest.
Mr. Richardson, Mineralogist.
Storey B. Ladd, Topographer.
Mr. Amelung, Assistant.
Mr. Miller, Assistant.
Mr. Michel, Assistant.
Harry Yount, Hunter.
Mr. Kelsey,
John Raymond, Cook.
Steven Hovey, Chief packer.
Green, "Frenchy", Joe Foster, John Wilson, Assistants.

Aug. 12. March down Hoback Creek into the Canyon. Trail very dangerous. One of Eckles' mules down. Geology curious and complicated. See Sketch book.

Aug. 13. Out of Hoback Canyon to Snake River and up same some ten miles. Eckles has fallen behind. Wilson crosses Snake River. See curious conglomerates 40 to 50 feet thick folded with the cretaceous. Dip 30 degrees in some places. Find oyster beds

beneath.

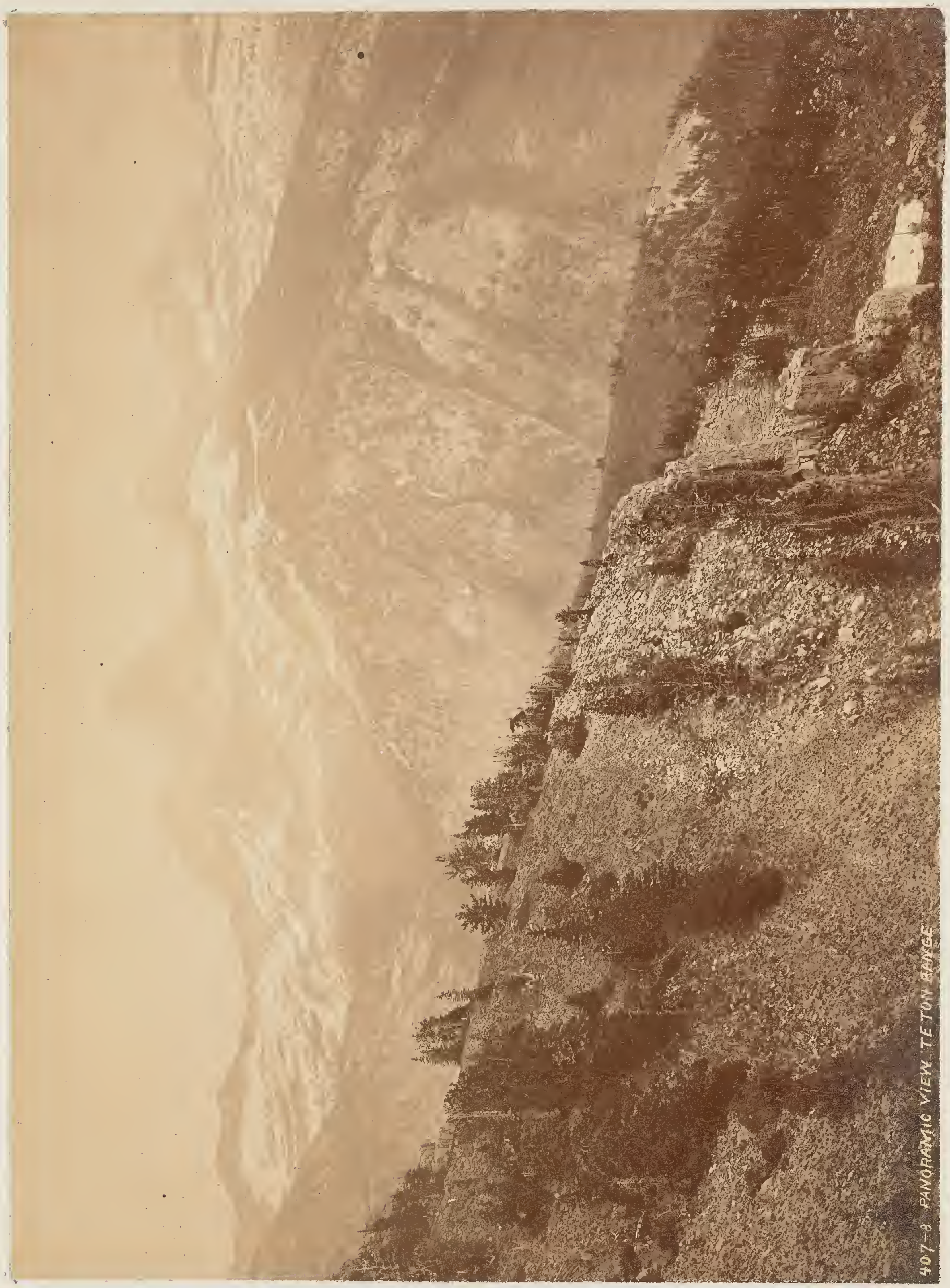
Aug. 14. Up Snake River to base of upper Grosventre group. Find fossil leaves in the beds by river under conglomerate and near same horizon as oyster beds of yesterday. Much wood and carbonaceous matter. Ascended lower Grosventre route and made a sketch of Teton Range. View up river very fine. Worthy of painting. The Tetons, high and steep, are quite dimly gray with patches of snow. These catch the eye as clouds. Stream runs down toward me in sinuous lines and the bodies of cottonwoods, pines and willows are very picturesque. The flats are gray with sage and yellow with grass. Distance smoky, reaching up into pale blue with soft clouds.

[illegible]

Aug. 15. Made sketch of Teton Range from top of Grosventre Butte. See sketch book. (The sketch books referred to are all preserved in the archives of the U. S. Geological Survey.)

Aug. 16. Rain. Jack shoots two fawns. I sketch a little in the afternoon. Rain. At breakfast: "I can just as well go on by myself." "No, you will not; nothing of the kind. I will arrange this. I reckon my decision amounts to something here. It is final. Things are now arranged just as they should be." This is the reason why I did not pack up and go to the Shoshone without Steve. Camp First Creek

7



407-8 PANORAMIC VIEW TETON RANGE

on south side of Shoshone Lake. Geological observations omitted.

Note. Came upon Gannett and Tom on Mount Sheridan at 10 o'clock. Descended to Hart Lake and camped near the Geyser Basin. Woodland Group, Hart Lake, Geyser Basin. Stockade Geyser; Rustic Geyser. Eruption at 7:30, August 21; at 9:30, August 21; at 9;45, same date; again 12 minutes later. Saw the eruption of the principal geyser. Heavy masses of water thrown 6 to 10 feet in height and a few jets to 15 or 20 feet in height. Water in basin reduced in level only one foot. Lasted one or two minutes. Another eruption heard at 10:30, and so on.

On Flat Mountain, geological observations omitted. Extended geyser observations omitted.

The Gorgon Geyser keeps up a constant groaning, thrashing about in gigantic yet unavailing struggles to be free. Other geyser notes omitted.

Aug. 23. Camp on Hart Lake. Had breakfast noderately early. Took a few geyser observations, saddled up and started for Flat Mountain. Followed a sand bar around the border of the lake for nearly half a mile. Through the bar near camp flows a moderately large creek of clear water. Outside of this bar is a large meadow area without lagoons. The creek meanders through these meadows. There

seem to be a number of hot springs and pools in the meadows. The Creek runs over a bed of find sand and has a firm bed for fording. The beautiful curved and ledged bar around the lake is composed of loose volcanic gravel and coarse sand. The lake seems quite shallow, however, toward the border of the west end. There seem to be trout and a few pelicans swimming about and loons laugh.

We entered the heavy pine timber by an elk trail which led us up the gentle slope through small parks and delicious forest. A mile up we encountered fallen timber and undergrowth, and at the creek which flows down the face of Flat Mountain and turns east toward the lake the traveling was quite tedious. The forest is not of large growth but very dense and continuous, there is a break from the lake to the summit, a distance of 10 miles (air line) and say 12 with meanderings. We were a little over 3 hours reaching the crest of the bluff, which lies immediately over the S.W. arm of Yellowstone Lake. The butte has a pretty large area of flattish surface. The East and South slopes are gentle, but north and west a sharp bluff face extends around the Mountain a few Short angles extend out from which fair views can be had of the country west and north. The view

of Yellowstone lake however is especially fine. Every arm and island being visible. Set in the framework of dark, somber greenish gray forest with the ornate border of gray pink and blue mountains reflecting on its half polished surface the sky and its luminous clouds. It has a most brilliant and refreshing effect. It seems now more worthy of the highest encomiums that have been heaped upon it than from any other point of view. Directly under us is the west and two (?) thousand ? feet below is the end of the south west arm. Into this flows a small stream which drains the northern faces of the Flat Mountain and is perhaps in its northern branches two or three miles long. At its mouth are a few meadow spots. The area drained is all wooded, with some dead limbs, and the slopes of the valley are gentle and rise 200 to 300 feet.

The shores of this arm of the lake are straight and steep, being for the most part timbered but somewhat bare towards the head. Along the shore line are some short bands of beach. Mostly the banks are steep and there are a few outcrops of volcanic rock. Beyond the arm is a broad belt of timber in which are a number of yellow meadows in some of which are pools of water, which are mostly nearly covered with lilies and other

vegetation. (See sketch in large book). Beyond this is the bogus lake arm which turns out to be a separate lake between which and the lake proper is a wide belt of timber. A bay of rounded shore line extends outward toward this little lake however, and no doubt aided in deceiving the gentlemen who first sketched the lake. The timber is dense and heavy. The hills are low.

The rocks in the face of the butte are chiefly gray trachytes with seams or spots of pinkish, purple, gray and orange. Most of the rocks is of very low specific gravity, especially so a piece from the summit which had been brought of by a root of pine tree. Much of the rock has a sinuous lamination which gives it an appearance of schist rock. In other places the mass of the rock seems to be an aggregation of spherical crystals from the size of a pea down. Geyser observations are omitted.

Rustic Geyser. This geyser, the only one of any consequence in the Heart Lake basin, is situated over this northern border of the thermol basin, on gently sloping ground. Within a few yards of this border the forest and steep mountain slope commences. The area covered by the silicious deposit is about 32 feet in diameter, being a circle

with the opening for water flow on the east or lake side. The basin in which the water stands is about 9 feet in diameter, the rim being roughly hexagonal in shape--the result of an artificial enclosure of small pine logs which have been placed thus by visitors perhaps a year since. These logs are entirely covered by a silicious deposit of yellowish color and most beautifully beaded, although half buried in the deposit and covered to the thickness of an inch or more. The positions and shapes of the logs can be easily traced, the broken limbs and knots appearing as great nodes and hummocks of beautifully crystaline brown sugar. Other lesser branches of trees can be traced over the [illegible] covered area and I am led to suspect that there was an attempt made by the supposed visitors to place them in the form of a star about the basin. If this could be done, the effect though probably too artificial to please critics would have produced a most pleasing result. The basin rim thus surrounded by this curious sugar coated frame work suggested the name Rustic which was for the time given it.

The formations about and outside of the rustic rim are very like those of other geysers

of similar deposit. Small scalloped basins of irregular but beautiful shape filled with clear water at the bottom of which can be seen the beaded pebbles of geyserite, many of which are colored with brilliant green and orange and loose ones are polished on the under side, having been kept moving about by the water.

The spaces between the scallpped bordered pools are filled with coarse gray beadwork like cauliflower or are smooth shallow basins or terraces tinted with the richest possible colors, cream, pink and orange and greenish yellow prevailing. Those colors in the flatter parts farthest out from the vent are thrown together in a manner most artistic and altogether inimitable. A mackerel sky with whitish ground and pinkish pearl and orange clouds may be seen-salmon color. The ripples of water in yellow,salmon and white streaked with rich browns may be imagined. Around the upper rim the depression in which the water runs and circles to the right and left, the colors are dark brown;the same is the case with the sinuous channels down which the ejected water runs toward the river. On the lower side the gentle slope falls off in terraces of beadwork inclosed pools.

The basin is funnel shaped, the aperture being near the center; the sides slope regularly down to the bottom or tube opening which is perhaps 5 feet below the surface. The tube seems nearly circular, is 12 inches or more in diameter; the walls as they descend being somewhat irregular. When at rest the water stands within about one foot below the top of the beaded surface and touches the under side of the beaded logs of the frame work. Above this level the silica covers everything. Below the basin is lined with a whitish, irregular coating, without beading (this is proof that the water never falls below this level). The water is almost perfectly clear, looking a little blue in the deeper part of the basin, and quivers or pulsates slightly for the ten minutes following an eruption. This quivering motion is presently changed to a boiling condition by small bubbles of steam rising through the water. For two or three minutes the boiling continues, growing gradually more pronounced, the water meantime rising two to three inches in the basin, where suddenly great bubbles rise and throw~~s~~ a heavy body of water into the air. This is followed quickly by others until the waters of the pool are in a violent state of agitation, the broken masses of water being thrown

in every direction breaking into great ragged drops and falling on the beaded surface. While the air is full of masses of water other strong upthrusts occur which throw jets through them high into the air, the whole being a most beautiful and interesting--not to say exciting--spectacle. The pulsation or upthrusts of steam bubbles lasted from three-fourths of a minute to one and one-half minutes and numbered from 40 to 50. Toward the last they were less strong and less frequent than toward the first, one sinking before the next arose. When the last had risen the water sinks rapidly to the usual level and for 10 minutes to twelve all is quiet. The volume of water ejected would amount to only 3 or 4 inches from the top of the basin.

Continuation of Flat Mountain Notes.

Beyond Bogus Arm the great western arm of the lake could be seen, being well represented by the maps excepting in a portion of the northern shore which has a deeper bay than is shown. Could see the group of hot springs on the Southwest shore and the little ridge on which we were benighted in 1872. The timbered slopes rise quite gradually from the lake to the south and west but grow steeper toward the slopes of Elephant back. There are but few meadow strips on the shore and none in the timber of the hills. On the north the outlet could be seen, the flats of pelican

awk with the white hot spring spot on the dark hill beyond. Steamboat Point and the mountains to the east. There were the fine islands and the promontory point with its knotty half forest covered hills, the meadows at the head of the lake and the densely timbered ridges to the south. These latter hide the upper Yellowstone Valley about the head of Pellican Creek and directly east of the northern post of the lake the timbered slopes rise pretty gradually to an extensive series of rounded but often sharp pointed summits of red gray color among which at the south are Mt. Sangford and Mt. Stevenson. Back of these and extending more to the south are sections of a very different appearance--rugged,steep faced, deeply scored and dark that show massive horizontal bedding and rise to superior heights. Beyond East fork are the Vol Cengtomerate Mountains which have a similar appearance.

Columbia Spring, Heart Lake Basin.

The chief spring of the group. 40 feet diameter. Large volume of water down to Lake. Has large charge channel . Formerl built terraces and killed much forest. 200 yards to Lake.

Basin irregular in outline and contour, deep and capacious, irregular rounded shelves most prominent of S.E. side. Under water gray color covered with rounded nodules, very deeply scalloped rim. White on edge, which is finely scalloped. Edges thin 163 inches thick, smooth above, often projecting and in places fallen in. Orange and gray greenish

yellows back of rim. A gray, clear deposit outside of this. Stream and gray bottomed white and yellow borders with beautiful white darker centered ros islands. Arms of spring long; one is partly bridged across.

Mount Sheridan. August 23.

As we ascend, the broad, dark plain spreads itself out before us and lake after lake breaks upon the view. Heart Lake, half hidden in the fog and polished most perfectly reflects the cloud-filled sky so that one seems to look down through the somber forest into a world below. Following this comes the many armed Yellowstone Lake with its satellites. Then Shoshone and Lewis Lake to the west. There also were the Beula Lake far southwest.

On leaving camp, August 23, I spent a few minutes taking notes about Columbia spring and the geysers, then rode to the left up an open way that leads up to Mt. Sheridan, 400 or 500 feet above camp. I came upon an outcrop of whitish and yellowish rock with feruginous weathering that proved to be porphyry--a creamy white macro crystaline trachyte. Of this I obtained two specimens (10, 11). There is a large thickness of this rock, indeed it with similar varieties extends almost to the summit of the peaks. There ore occasionally outcropt however, of masses of darker rock which at a distance might be taken

for trachyte. Many of the masses it appears are only apparently dark from the weather stain and coatings of iron. In the slides, however, were numerous fragments of darker rock, a dark gray slaty looking porphyry ofter apparently brecciated. Midway in the steep mountain face there are heavy outcrops of a dull pinkish or reddish porphyry that is quite firm and compact but has frequent layers of whitish material that give the rock a woody or grained appearance and are probably flattened vesicles filled with calcereous or other matter. See specimen.

These rocks so far as I could determine are not bedded with any detree of regularity but to my right, midway between Red Mountain and Mount Sheridan and near the summit of the connecting ridge there is a long precipice face in which a regularly vedded series of rocks occur. I was quite unable to spare time to visit this outcrop. It is not impossible that the weathering in the other spines or amphitheatres of this face of the group was favorable. A more distinctly bedded character might be detected. The summit of the mountain has a small area of brecciated porphyry (13 ?) which has a thickness of, probably 40 feet. The included masses are angular and various sizes and materials (all volcanic). Some of the fragments are as much as 4 and 5 inches and perhaps even more.

August 24, 1878.

Breakfasted and broke camp today early. Collected two specimens on the Lake shore near camp--a reddish porphyry and a dark laminated or drawn on vesicular obsidian porphyry. The sands and pebbles of the beach are entirely volcanic--mostly porphyries. Many of the fragments are large and none seem to be fully rounded. There are no quartz pebbles whatever. The outcrops are not large and are of the dark variety and quite rotten, so that it is hard to obtain a well shaped specimen. The bar that encloses the Lagoon or swamp is a mile or more in length. We were at the west end. Saw a number of deer on the bank at the east end. There are other outcrops of porphyry on the east shore. From camp I let my mule retrace his steps through the delightful forest to the foot of Shoshone Lake. There are many grassy parks by the way and much beautiful open forest. There are no outcrops and no fallen timber. When near Shoshone my mule Billy lost the trail and Gannett rode ahead.

The Elk Chase.

On emerging from the timber into the swampy meadow by the lake I happened to be in the lead again and on looking across toward the crossing at the foot of the lake I saw an object in the timber that skirts the bank, that looked somewhat like a deer or elk. The object was perhaps a hundred yards off and I was uncertain but immediately put a cartridge into my fifle and sprang to the

ground, falling on one knee I was about to fire, but feeling still doubtful and not wishing to fire at a stump I called to Gannett to ask what he thought when Tom spoke up and said, "why that's only a root." I rose to an upright position and at the same moment the strange object which was really a magnificant elk with huge branching antlers turned leisurely about and trotted across the ford, climbed the opposite bank and stopped in the timber. Being exceedingly out of humor that such a chance should be missed, such a chance as don't come twice in a season perhaps I immediately fired at the obscure form amongst the pines but my gun was sighted for 100 yards and the ball fell at the animal's feet. He turned leisurely and trotted through the opposite mountain slope. Almost without a hope of getting a glimpse of the old fellow again I crossed the ford, hitched my mule by the Lake shore started up through the forest afoot, [illegible] hurrying along. My attention was called to what appeared from the similarity of sound to be a wolf or fox barking. This sound came from several hundred yards above me and to the right. A little farther on I happened to remember that elk have a curious call when searching for or expecting companions and at the same time I observed that the sound was much more sonorous and musical than the bark of a wolf and immediately arrived at the conclusion that the old buck had not fully determined our character and that he was calling with the hope of extracting a reply. Creeping up a little gully, guided

by the oft repeated call, I was nearly out of breath when to the right through a slight opening in the trees some two hundred yards away I caught sight of the tawny shoulder and sides of my victim. Aiming at him near as possible at his heart I fired, but the animal turned and disappeared. Following up in the same direction with ~~c~~ caution, hoping still another shot I heard a thumping in the pine bushes and hurrying on was delighted to find the magnificent creature in his death throes. The antlers were fully developed and upwards of three feet in length. I shall of course preserve the head and bring it east with me. Calling my companions we set to to butcher the dead elk. The weight was that of a medium sized beef and the task was not light, but the idea of having fresh game for the camp again to take the place of the omnipresent bacon nerved us up to do wonders. We were still ten miles from the main camp and as it could be impossible to take a sufficient quantity of the meat to camp with us my companions resolved to ride immediately to camp and return with two pack animals which would enable us to secure at least 400 pounds of meat. As Dr. Hayden was expected to arrive soon with Mr. Jackson's party a large amount could be used.

While they were gone I undertook to prepare the head for transportation. Not finding this very gratifying work I soon set out to examine the geology of the lake.

In six hours John returned and we loaded our prize

and hastened to camp.

Shoshone Lake like the other lakes of the National Park is surrounded by low rounded densely timbered table lands. It is quite impossible to get fine lake views excepting from the high distant mountains. There an occasionally open but swampy meadow at the mouths of the inflowing creeks. But a bare hill or promontory of ordinary height would be a notable object. It will not be difficult, however, to cut the timber from the best view point and in time doubtless this will be done ; for although the lakes of themselves would not be sufficient to induce visitors to undergo the hardship of a trip to such a wilderness, the various hot spring and geyser basins are not superseded by the greatest wonders the world can produce.

August 25.

With Peale I took a look at the Shoshone hot spring and geysers (see another page).

Started with Gannett and went ~~to~~ a cross divide to Madison river and Lake. All the way up is the picho~~tem~~stone and laminated pitch porphyries, poor exposures. One good outlook toward the lake on the too flatish divide I got a specimen of light gray pumaceous rock. On the meadow side came to an extension;outcropping of the porphyries in layers dip 80 to 90 feet . Strike east and west. Crossed one half to three fourth miles in thickness of these rocks. In the butte to the west head of Bachlors fork there are extensive outcrops

whole time. The main force of the upper geyser was exerted near its south-east rim. There was a grand exhibition of energy which lasted near three-fourths of an hour, stopping occasionally for short intervals. Huge whirling masses of water were thrown into the air breaking to gragments and falling toward all parts of the compass. One does not dare to venture near as the jets of water reach unlooked for points with amazing brevity of time. The blue, deep water of the lower part of the pool was thrown into a great state of agitation and rushed with great force through the narrow gateway into the lower basin. Great quantities of water surged over the low ridges of deposit and turned down the slope into the pools again. The straighter jets were frequently thrown to the height of 30, 40 and 50 feet. (see sketch in notebook No. 2.) At dark gthere was still an occasional spout. West brought me a specimen from the twin buttes. Gannett says they are conglomerates.

Worked awhile on wrapping specimens. Determined to go to Twin buttes. Crossed the Madison near the lakes. Passed over some ridges that looked like moraines. These are probably however only disintegrated conglomerates outcrops. How the lakes are formed I cannot say. Crossed a timbered space and afterwards a meadow in which are a number of hot springs. Climbed the north butte through dense young timber. Found the rocks to be volcanic conglomerate similar to those between the forks of Madison. They lie nearly horizontal;

of the black pitchstone bedded with lytite colored and yellowish laminated porphyries. Dip has changed to about 20° south and 10 to 18° north of east. The yellow beds are mostly vesicular and scoreaceous in appearance. The vescicles are sometimes filled with rotten spheres reaching 1 1/2 inches in diameter. Beds are dipping at a steep angle until the head of the Madison is reached where they seem more nearly horizontal. Hot spring formations in valley. Bechler's Amphitheatre below is very like a crater form and unlike other topographical features but the weathering of the cliffs which with the debris slope are 60 to 80 feet high weather in the ordinary rough irregular forms. The bedding is in general apparently nearly horizontal but there is considerable curving. The rocks are the so ordinary darker obsidian porphyries.

In continuing our course down the high right side of the valley we came upon another crater-like amphitheatre about 150 yards from the former. Like the former it opened out to the north into the river valley. It had also the curved wall of dark volcanic rock around the head but instead of being 60 yards wide by 300 long and say from 30 to 70 feet deep like the former it is half a mile long opening out gradually below and toward the head steep and vertical, having a width of 100 to 400 yards, and say in depth 200 to 300 feet. Descend between the two amphitheatres. We soon reached the second and larger of the broad swampy meadows. The sides of the valley at the amphitheatres rise to the

height of 400 to 600 feet, but are not properly walls; at the meadows the slopes are gentle and the elevation decreases to 100, 200 or 300 feet. Before reaching the bend of the river we passed some groups of hot springs but had no time to stop, the bend of the river (see map) is in canon, the walls of the ordinary volcanic rock being from 100 to 400 feet high and very steep. Passed around the canon and down to the falls and late in the evening reached the head of the upper geyser basin. Looked with delight upon the scenes of six years ago and felt the thrill of etc.,etc.

Found camp just below old Faithful. Before dinner was over we had an exhibition of the powers of Old Faithful. Later the Giantess Phrigia followed by the Grand and afterward by Old Faithful and the Giantess again. The wonder seems greater than ever. Our memories certainly fail to retain impressions in any way equal to the reality. Walked around the upper part of the basin with Hayden and Eckles. The Beautiful circular hot spring by Castle Geyser has been much injured, a part of the rim having been broken down.

August 26-27.

Toward morning the Beehive spouted and in the morning the Giantess spouted again. The Castle seemed to be ready to spout but sent jets only about 20 or 30 feet. Spent most of the morning in camp preparing my elk hide and sewing up my pants.

In the afternoon walked out with Eckles and others to where Jackson was photographing, saw some fine springs on Iron Spring Creek,--Heart spring, Lake spring and the Little Buster geyser, etc. Came back through the woods toward the Giant. Passed it and went over to the Grotto which was doing a good deal of spouting in its way. While here I noticed a little geyser throwing a jet 15 or 20 feet, a few hundred yards below me. Walked down that way and was favored with one of the most grand and enchanting sights it has ever been my good fortune to witness. On the opposite side of the river which here is comparatively quiet and some 40 feet wide stand two low geyser cones or piles set into the gray domed bank and projecting slightly into the river. The upper one suddenly ceased as I reached the bank and the lower one began to sputter, very quickly a splendid fan-shaped jet was thrown into the air and its thousand darted jet trembling from right to left to the left and beyond this within 6 feet a second stream of steam and water of unexampled beauty was projected into the air to the distance of 100 to 200 feet and what was most surprising was that it stood at an angle of 40°, another little jet nearer me shooting out at a similar angle towards me.

It is quite impossible to describe the wonderful spectacular display that followed or to give any adequate idea of the beauty of the two principal jets or of the resistless force with which they were projected upward.

For over a minute this eruption continued amid much waving and rolling of steam. Suddenly the effort ceased and the jets sank back while at the same moment the other vent above which remained quiet while the jets were playing began to puff again, this had hardly continued a minute when the three jets first were again shot into the air precisely as before. This lasted again for a minute and ceased, the other playing steam meantime. For ten successive times this gorgeous display was repeated. At the end of this time I found myself quite weak from excitement. I had been jumping about trying to measure sketch and see. There were the jets peculiarly beautiful, the smooth river reflecting it all, a most brilliant rainbow hovering all the time in the falling spray. All set off by the dark timber behind and the blue sky above. I felt when all was quiet as if I had seen enough for one day. I cared to look at nothing else.

The ninth period was a little weak, the tenth and eleventh quite weak. The whole display lasted upward of half an hour.

With Mushback I saw the White Cone and the Punchbowl outcrops of brachyto near here.(Dit 705) and as we returned toward camp the Grand and Beehive gave us an exhibition of their powers. The former made quite a fizzle.

Mr. Eckles brought from the cliffs beyond Iron spring creek a yellowish rock of the sanadni trachite character. He

says the bedding is very irregular, etc. West brought me some specimens from the east side also. In the evening put up specimens and afterwards witnessed a grand show of Old Faithful with artificial light, calcium and fire light.

August 28th.

Morning in camp. A few camp pictures taken by Jackson. Also an instantaneous one by Jacison of Old Faithful. Mr. Jackson intends to continue all day the work of making instantaneous views of this geyser. Mr. Gannett's party consisting of Gannett, West, Cooper, Graves, George Boalin and myself are to camp in the lower geyser basin tonight. I mount old Jack and take a look at the geysers on the east side. The Beehive which spouted while I was still at camp is quite quiet. The Giantess is full to the rim and the pool is extremely fine, large and beautifully colored.

Another geyser of which I knew nothing before lies in the lower course of this group. Crossed by the Sawmill and Grand the T   was spouting a little. This geyser seems to be absorbing the Grand. Passed down the trail by the Grant Gulch Riverside and Fan and when half a mile below the matter met two footmen in buckskin garb and with weary g   who turned out to be Mr. Wilson and Harry Yount. Their outfit had been set afoot by the Indians 8 miles below Henry's Lake and so they were struggling in to the upper geyser basin with the hope of meeting some of the other parties.

Crossed the river near the north of Iron Spring Creek and followed Gannett past the hot spring and geyser and up the rocky cliffs. Here Gannett was making a station. Collected a piece of the trachyte which is here exposed in great irregularly bedded (?) masses or sheets. Exposure of pebbles 200 feet. Texture etc. uniform within certain limits. Told Gannett of Wilson's misfortune, whereupon he returned to the camp, upper basin to consult with Hayden and Wilson. West and I rode hurriedly down the trail. Just below the middle Geyser basin we were accosted by a horseman with gaudy buckskins and feather who issued suddenly from the woods. It was Col. Norris, superintendent of the Park. He was on his way to the upper basin. His men were just behind him cutting a wagon road up the valley. Learning that our outfit had camped with his in the old camp ground of '72 in the lower basin, West and I concluded to wait for Gannett so that we could make a station with him if he desired. We returned to the great springs and spent nearly an hour reviewing what are certainly the grandest springs in the world. The Great Blue Spring of which Moran has made the water color drawing has recently been in a tremendous state of disturbance, very probably a gigantic eruption as the walls are torn and distorted and great masses of rubbish and broken geyserite lie heaped up a little distance back from the cave hollowed rim. There is a lively boiling going on all the time nearly all over the

surface. Great masses of the walls have fallen in.

The great boiling lake above with its thousand gorgeously colored treeaces is as wonderful and perfect as ever. Its magnificence beggars description. There are also other fine springs in the group.

About 2 o'clock Gannett and Mushback came down the trail leading each a mule. They were on the jump and we hastened to join them. The mules were intended to fetch Kelsey and Ladd to the upper basin. Norris' force returned to camp with us,--the first passengers over this part of the new wagon road.

In the evening went back to a little butte near camp. Found it composed of an exceedingly irregualr conglomerate. The strike is nearly east and west. The dip some 50° to the north. The pebbles and sand are nearly all--or all-- of volcanic origin. The larger masses pretty well eroded rounded away may be as much as 8 or 10 inches in diameter. Mixed in with the coarse conglomerate and fine conglomerates are whitish and hellowish sandstones of all degrees of fineness of texture down to the very finest. (see specimens) These fine sandstones seem to be mixed in with the conglomerates in pockets rather than as continuous beds.

There are half a dozen or more hot springs in the little wash between this butte and camp. There are two buttes north of thisand close to it while another stands a quarter of a mile below. The rock is probably the same. The walls of the

valleys between the upper and lower geyser basins seem to be uniformly of trachyte with more or less of the pitchstone in the upper strata, or atop of it.

Mushback, Kelsey, Ladd and I the returned to the upper basin. Capt. Norris stayed with Hayden. Phil Boetler is with Norris. His team also. Old man Bush drives the wagon. A scout who carried the mail for Norris reported that Stevenson in at the Mammoth Hot Springs with grub and that a large Indian trail was found crossing the park from toward Henry's Lake to the Yellowstone. It is also reported that Steve Hovey who was some days since sent ahead for provisions was seen yesterday on the Yellowstone Lake, having lost his course and much time.

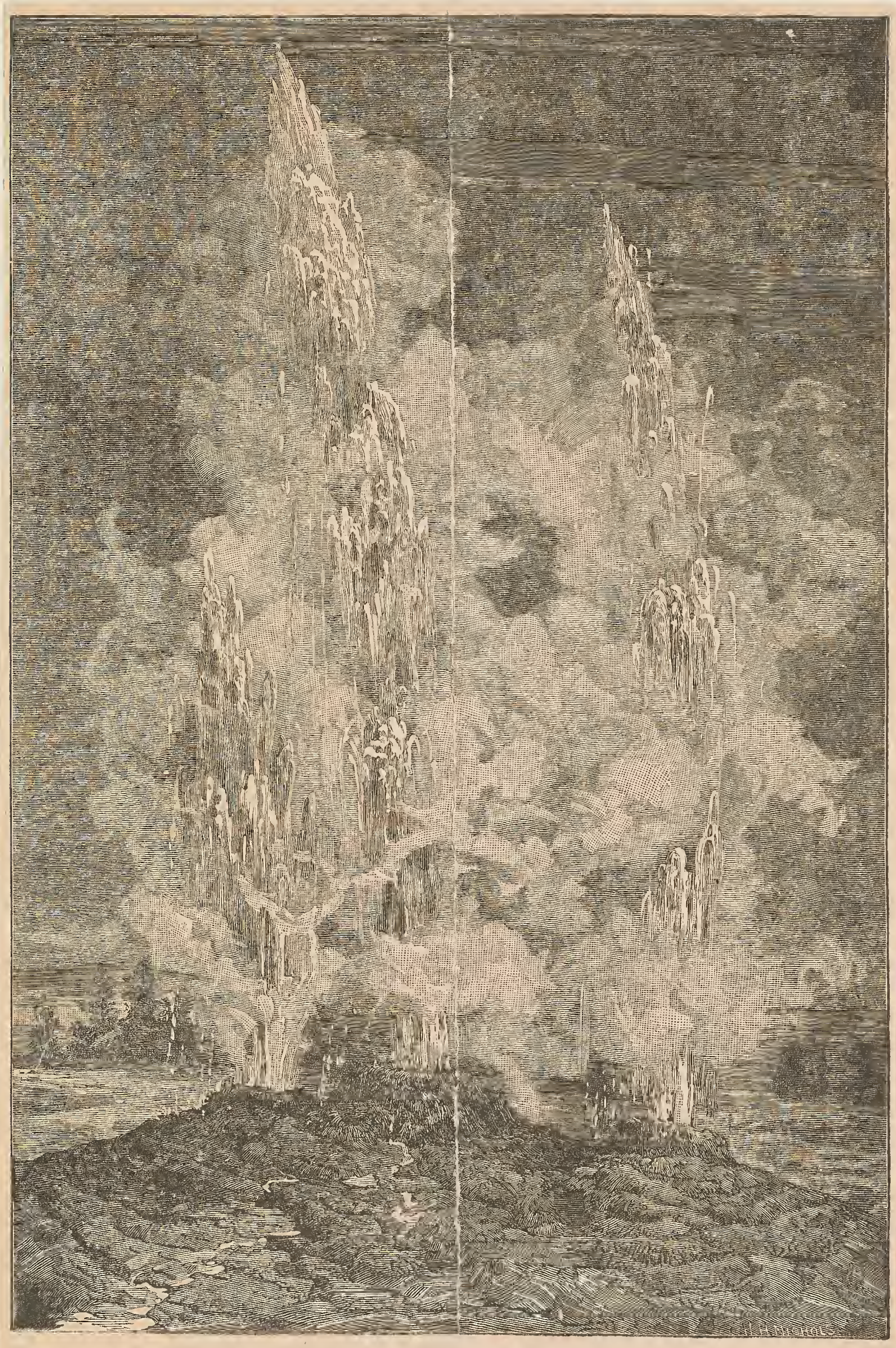
August 28.

Gannett's party remains in camp. While the road makers move up to the middle basin Tom goes to the upper basin for advice from Dr. Hayden. Gannett and I ride up the basin to see the hot springs and geysers. All seem to me to be finer and more interesting than my memory depicted. The lone geyser of the group is a very interesting one. As we stood near looking at the great pool, a heavy mass of steam came up and with an explosive sound sent a great quantity or sparkling steam wreathed water into the air. We looked on quite astounded at several repetitions of the same phenomenon. The highest jets were thrown to a height of 50 or 60 feet.

We found a number of the smaller geysers near the hill top at work, one throwing jets almost continually to the height of 20 and 30 feet. Above the latter and on the summit of the bare part of the hill stood the quiet pools of two very fine geysers. The extent of the deposits, the character of the pools and vents indicate probable great power and fine eruption.

The mud puffs are as of old. I procured a specimen of the vedded volcanic grit that caps the hill by the Mud Puffs. There was no dip or strata apparent.

Gannett returned to camp and I went on the the upper part of the basin, passed the voluminous streams that came down from the "Steady" geyser. Stopped at the old geyser cone and afterwards spent an hour at the "Great Fountain" witnessing meantime one of the finest exhibits within my experience. Instead of being a second class or doubtful first class geyser it proved by this eruption that it ranks among the very first. Had I not just witnessed the Fan geyser I should have pronounced it the finest show of the season. I noticed on approaching that the basin was filled to the rim and that there was considerable boiling about the edges and consequently anticipated an eruption. Presently it came and with a splendor that I was not in the least prepared for. Exquisite jets and [illegible] columns of water, enormous in quantity sent upward. Jets from the central part of the basin reached the height of 140 or 150



Union Geyser in action, Aug. 21, 1878; 7.46 A. M.

Drawn by R.N. Brooke
who had never seen a geyser
in action — not at all bad

the cluster of jets breaking from the main columns in dart-like points and trembling into the surrounding pools in showers of crystal drops. After a number of feeble efforts a second grand eruption took place. The hundreds of arrow-like jets shooting through the mass of loose whirling steam and descending into the pools toward all points of the compass. Again it quieted for half a minute and again sent up a magnificent gothic pointed column more perfect than either of the others and to as great a height as any geyser column that I have seen. A fourth time this was repeated with almost equal force, and the there was a lull. I walked to the rim and found that the surging water had fallen some 10 or 11 feet in the gigantic tube. The eruption had lasted about 8 minutes. Time, near noon. A few minutes later the action was renewed but with less force, the columns not going above 50 feet. The whole of this exhibition resembled that witnessed by me in 1872. This lasted about 5 minutes. After a lull of about five minutes there was another and still more feeble attempt and as I rode away there were two or three other light spouts.

See [illegible] drawing farther.

Passed down over a hollow-sounding bottom then out through the fallen timber to a spur that lies east of the road between the Madison and the Geyser basin. Found pict within a few hundred yards of the Madison and just above road an outcrop of curious vol breccia. Large masses of a dark softish glistening rock seen piled and half welded

together. A heavy mass of this ten feet thick outcrops on the south side of the ridge. (see fragments of specimens) A hundred yards farther on is another outcrop of somewhat similar looking rock but not brecciated. From a little distance it looks like a coal outcrop and closer like a loose compacted massive sandstone formed of coarse black sand. It looks to lie nearly horizontal. The other has an apparent dip of 30 or 50 detrees to the east. (see fragments) On this ridge are also, apparently, the ordinary trachytes, mostly however like the specimens from the Mud Puffs. These are loose masses not apparently rounded of other varieties (see one fragment). Just beneath the latter formation (the dark sandstone) there is another outcrop of the dark breccia. The relations were not apparent.

Passed down to the trail and across the swamp to the low ridges which inclose the milky pool below. These ridges are probably composed of the same conglomerate as the buttes on the east fork side as they are in line with the strike. The lake is enclosed excepting a narrow gateway at the east. The hills are not more than 150 feet high. There are a number of mud springs behind the lower butte. Returned to camp. Gannett and West had gone to the twin buttes. John Raymond had been sent to Gardiners River Hot Spring.

Walked back to the Fountain Geyser and had the good fortune to witness an eruption. The two pools were full to the rim and overflowing. The lower one was quiet during the

are of all detrees of coarseness and fineness. The masses of boulders and pebbles are all rounded or semi-rounded. Not as river pebbles but rather as shore line pebbles. The bedding is exceedingly irregular. The coarse mixed with the fine on a regular jumble, yet with a traceable interbedding. Massive conglomerates with irregular layers of fine sandstone (same as in buttes north of --see specimens), and near the top of rather fine conglomerates which exhibits very marked cross bedding. Altogether there are at least 300 feet of these mixed beds exposed. The finer beds are quite thin and appear to be almost clay states. They are white or light yellow and generally contain more or less coarse pebbles. The largest masses seen were above 2 feet in length. These are probably less rounded than the smaller. The included pebbles are quite varied in composition, being mostly of volcanic origin. (see fragments) but there are fragments of geyserites, slates, etc. There are no granite rocks however, and no paleozoic fragments. The two buttes seem to have the same series of beds. Whether these strata continue south into the plateau or not I cannot say. (At the falls there are breccias, yellow-trachytes with metallic looking streaks etc. pitchstone at top). They certainly extend west in a ridge that connects with the north butte. There is a curious ridge extending east from the basin of the butte capped with huge masses of the conglomerates. There then are some upland parks in which there are buffalo

signs (the Mountain Bison) Some of the tracks are larger than I have seen by domestic cattle. Saw a couple of elk but did not get a shot. Came home by way of the Fairy Fall,-- a beautiful cascade the leaps from the summit of the cliffs or falls with a pulsating rustling sound some 200 feet breaking upon the rocks near the foot. The stream is small at this season. On my way home caught up with Col. Norris' outfit who camped with our outfit. (Saw Hot springs and geyser 10 to 15 feet oblique on map) There is quite an Indian scare, an official report having been received from Fort Ellis that a party of 70 or 80 Indians were breaking for the park followed by Captain Egan. Wild reports of their getting away with Stevenson, Hovey, Burnett and others.

August 31.

Remained in camp and read and wrote a little. Stevenson and Hovey came in from the Springs. Gannett goes up to see Hayden. Wilson returns to upper camp with his throdolite and reports the Aparepes all right. Feeling quite unwell.

September 1, 1878.

Norris and his party are off for the Springs. Three of the boys from Jackson's camp came down to go out with him. Their mules are to be packed by Wilson. Gannett and I start for the plateau beyond the Gibbon River. Follow the new Norris road until it leaves the Howard road. Reached the forks--the junction of Madison and Gibbon and seeing no

sign climbed the nearest outstanding spur of the plateau. Made a sketch looking up the Gibbon and Madison. All timber but a few parks, etc. (see sketch).

The upper 300 to 400 feet of the plateau is composed of a coarse,massive, grayish and yellow grayish light trachyte (see specimen) It was very difficult to get a specimen. Nothing of cabinet shape could be procured near the top. For 300 feet nearly the yielding massive rock weathers in round forms with the slope and is only partially covered by the disintegrated rock which rolls down the slopes as coarse sand. 600 feet by seem to be very like the top rock but in the lower part there are evidently much more compact layers (see specimen) The 400 or 600 feet from near the base to the middle of the slope consists of compact sometimes almost shaly reddish trachyte, finer grained than that above. (see specimen) At the base and near the hot springs there are large masses of reddish coarse grained somewhat spheralitic porphyry (see specimen) the relations of which to the superior rock I could not see. It is probably beneath them but it seems very probable that this section is not continuous--that the trachytes lie in somewhat irregular masses. The red porphyry of the base seems to run higher above. In returning from the Gibbon to camp I observed only trachyte similar in a general way to those of the plateau. There are no good outcrops excepting along the Madison. Mr. Eckles' party had come in during the day.

LOWER GEYSER BASIN

September 2.

Broke camp in the Lower Geyser Basin and began our march to the Yellowstone falls. Crossed the ridge back of camp to the trail on east fork. Followed a little valley that separates the conglomerate strata of the buttes from the massive reddish coarse grained rough surfaced trachyte that lies east of it. There are some hot springs on both sides of the divide in the little cross valley. Could nottrace the conglomerate beyond the creek. On both sides of the creek there are well marked cliffs of reddish trachyte--also grayish and purplish--much of it is finely laminated and greatly contorted (see specimens) On the north side where the road runs by the cliff there are large fallen masses.

There was nothing but this rock as far up as the bend in the river. The cliffs run out and the slopes are gentle. In ascending the dividing ridge by the Howard road we came upon a great variety of rocks. A white fine grained trachyte (see specimen) which lies about in large masses. Gray and purplish trachytes and a variety of grades of the pitchstone porphyries. There are but few outcrops. On the divide there is a pretty little lake 500 or 600 yards in diameter along the shores of which are collected in a curious jumble a great many varieties of rocks in large and small masses. A porous or fibrous, light, yellow gray trachyte, a hard black trachyte with white specks (decomposed sandstone)

a variety of pitchstones and spherolitic rocks. The amygdobs ranging from 1/2 an inch down. There were the harder gray purple and yellowish trachites without number. Lunched. Met this morning Jack Burnett and his English party.

Beyond the lake we came upon open country with some dead and young timber. Here Howard had camped. A little farther on we came upon a large sulphur spring basin--covering perhaps one mile square. In a depression near the center is a sulphur lake of irregular slope--some 200 yards in length. The water is of yellowish milKy color. All around the slopes of the basin are sulphur vents--the whole surface veing worked over and coated or spotted with yellow sulphur. There are scattering trees over the basin. Parks opening out to Alum Creek. These springs are at the head of Alum Creek. The underlying and frequently outcropping and much weathered rock is a coarse grayish loosely compacted gray trachyte with a slight tending to the spernlike structure. A mile below the Sulphur Lake we descend into a little glen in which are some sulphur vents and an outcrop of dark rock on the right, found the rocks gradation forms between trachyte and pitchstone. A purpled gray and heavy trachyte with slight tendency to the spherolitic texture occurred also. Masses of coarse grained pitchstone with spheres 1/2 inch in diameter having radiating structure; grades of rocks between these two were noticed. Some of the masses which here had large spheresules have rotted and weather-like coarse cellular basalt or even cinders. From this glan we soon came out upon the open hills, the

trees (brush) parting to the right and left of the creek which here turns to the northeast. There is a triangular shaped area of bare grassed hills and low rounded ridges enclosed by these two lines of timber and Yellowstone River. The Mud geysers at one corner, the Sulphur glen and the southwest and the mouth of Alum Creek at the other. On the steeper faces of the hill there are whitish exposures in which by digging with our hammers we came upon horizontally bedded sandy clays. There were no good exposures as the formation crumbles so easily. These are very probably the past pleocene lake beds mentioned by Hayden and Peale.

This extent here I believe to be pretty clearly indicated by the treeless district. Their want of compactness prevent the forest from growing although a few patches of pines are scattered over the area (see map in sketch book). There are a few masses of pitchstone and trachyte scattered over the area and the first pebbles of metamorphic rock were here observed since entering the park, and they were few. The material is very fine. In the middle part of Alum Creek valley are some small outcrops of pitchstone in which are enclosed small masses of trachyte. Also some trachyte From the summits of these hills we first observed the brilliant white and pinkish cones of the crater hills and soon afterwards the Yellowstone River came in view at the point where it is joined by Alum Creek. To our left was Violet Creek and the brilliantly colored hot spring district at its head. Just above this in the timber is the locality where

Boetler killed the fine elk. The timbered ridge on that side of Alum Creek runs down to the brink of the Yellowstone river and the timber extends down about to the banks of Alum Creek. Beyond the river, below the mouth of Alum Creek a low timbered ridge lies between the river and the extensive meadows beyond. After crossing Alum Creek over its mouth the trail is crowded up the steep slope of the timbered ridge but occasionally between that and the falls descends into the meadowed bottoms of small streams that come in from the west. The rocks, from Alum Creek to Cascade Creek are all dark and dark gray pitchstones. The river is broad and sluggish above the rapids. There is a good ford just above the rapids. The bare whitish slopes on the opposite side of the River are blackened by slides of granulated pitchstone. The timber is fine. The wagon trail exceedingly bad. Camped on the banks of Cascade Creek or rather the hill above it on the trail. On the Yellowstone opposite Crater Hills is a group of sage-covered, partially covered with timber,- hills (mostly east faces) which are probably also of the lake bed formations. There are come large sage areas also opposite Mud Geyser.

September 3. At Falls.

Rained all day. Wrote notes, made maps, etc. Walked down to the upper falls in evening. Rock trachyte. Saw crystal falls. They are very fine. The photo does them poor justice.

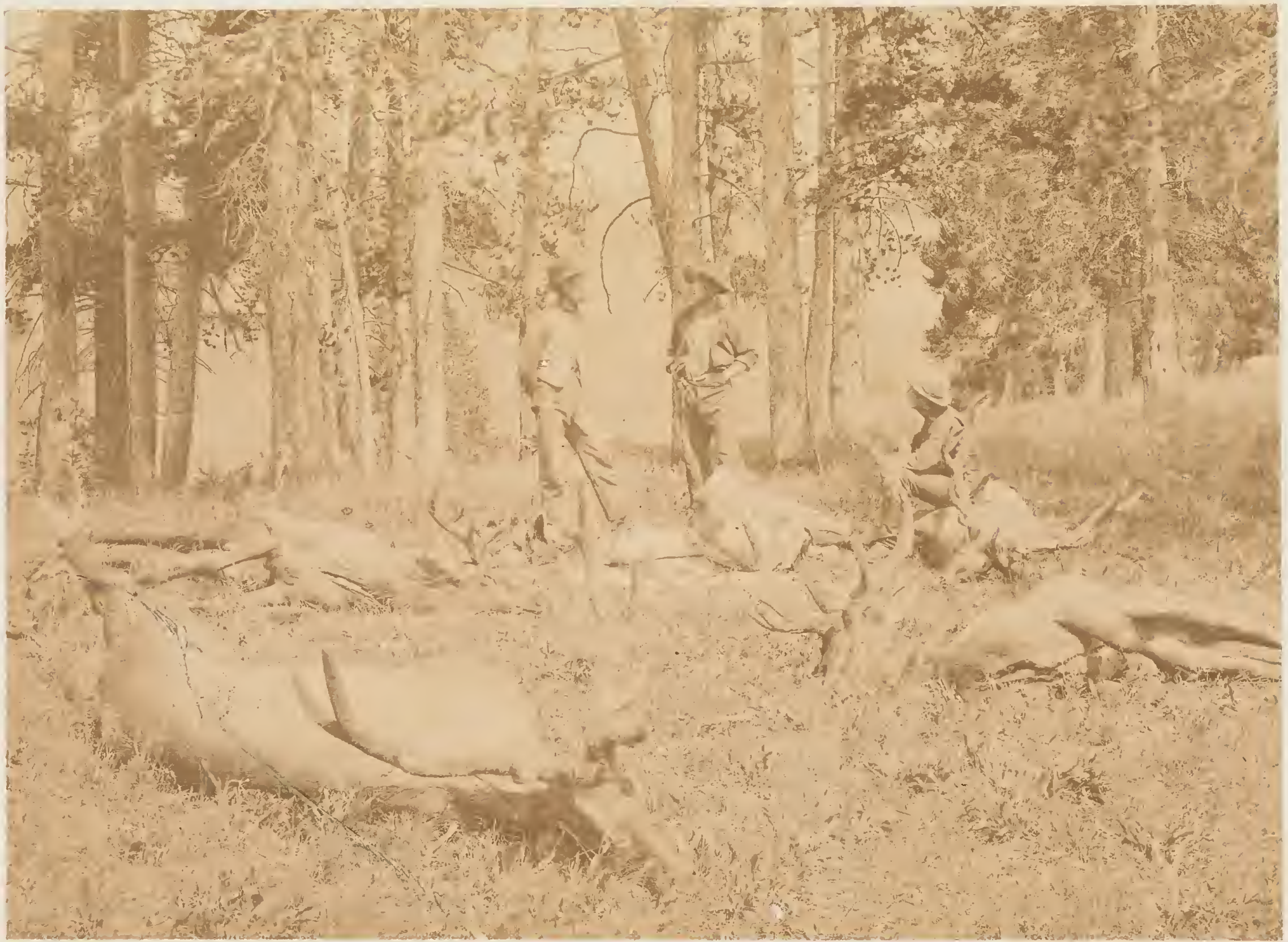
FALLS.

September at Falls.

Early in the morning a party of four soldiers and a guide

(122)

Re [illegible]



Chocolate plate

Joseph Savage   Mr Bingham

Bottler the hunter

5 elk at once by the hunter

Hayden Survey
Yellowstone Park [illegible]

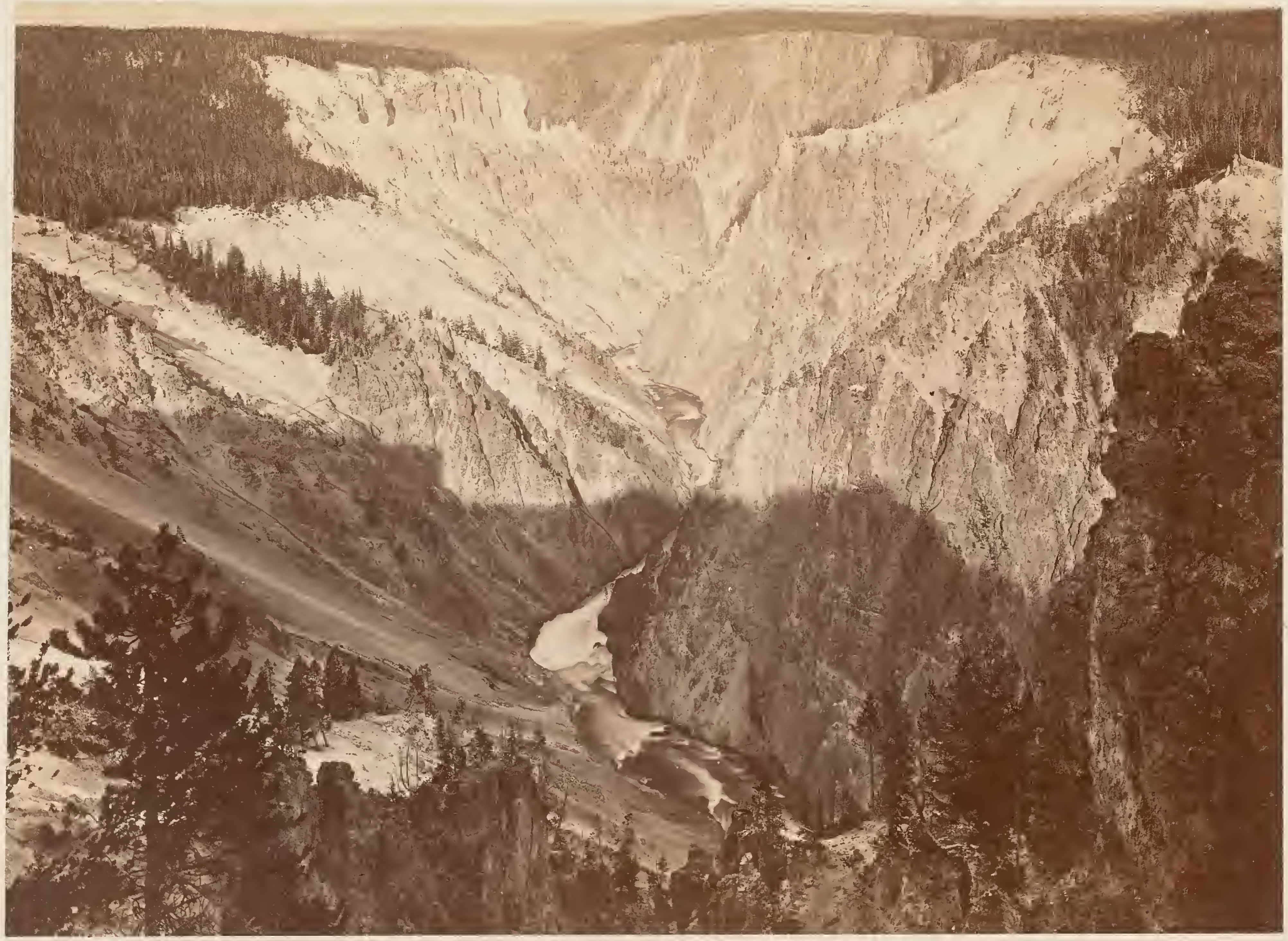
arrived from the springs. They are looking for Bannock trails and scouting generally. About 9 o'clock five of us--Eckles, Gannett, West, Midd and myself--cross the river at the ford at the head of the rapids, 3/4 miles above Cascade Creek. Find on the opposite sides above the upper falls and 100 to 150 feet above river an outcrop of coarse loosely compounded sandstone, horizontal. Grayish, greenish, etc., with some coarse grains, evidently past pleocene. Mr. Eckles saw down by the falls 20 feet of this horizontal sandstone; under it were near 30 feet of horizontally bedded sandy clays 50 or 60 feet, at base, above upper falls.

Assisted Gannett to measure lower fall. Have a very interesting time about the base of the falls. Got terribly wet carrying the line to the foot of the fall. Passed with West a very dangerous place. Note the glorious beauty of the falls with the wonderful green at the top and showing slightly through the fleecy shooting festoons of foaming waterfall. Walls of canon most rich in color, yellow prevailing on west with patches and streaks of other colors, darker being water at left. Collected a number of specimens of trachyte in sildes. Saw hot springs, etc.

In a number of places post pleocene sands, stones, and fine conglomerate set into notches in the walls. (see sketch in this book).

Mr. Eckles exclaims, with dilating eyes, "This is glorious," and the falls with the canon are without rival no doubt.

(24)



The canyon looking down
From over the falls

Climbed to the top and made a sketch from a rounded half wooded hill that overlooks the great glat that opens between the falls and the river below Sulphur Hills. On the sketch the timber is indicated, the sage and grass. I can tell nothing about the extent of the Lake beds backward from the river excepting that opposite Crater Hill is a hill or series of slopes that are probably composed of itrem. As to the valley, I cannot say. The hills by the river are probably mostly of those beds.

To my left as I look east there is a gulch that opens out to the river below the falls--say one mile. On the opposite side of it is a hill or ridge one side of which are springs. Also others at this head of the southern drainnge.

YELLOWSTONE FALLS AND CANYON.

September 5th.

Visited Falls. Stopped above lower falls; made sketch and map. Followed down one mile. Made station on white point first about 3/4 of a mile below falls. Collected some very pretty specimens of the white brittle trachyte. There are many sulphur vents below and the walls are very bright with whites, light yellows etc, Half a mile farther on is Promontory Point--a narrow white spur with a vertical face,, the most prominent point in this side of the river. The brilliant colors do not extend far beyond this. Say 1/2 or 1/4 of a mile. Beyond that the steep walls are composed of a brownish gray trachyte which weathers (at least while wet) very dark.

Turned back and crossed to Cascade Creek; found it

1 or 1 1/4 miles away. No lake beds, only grayish trachyte with the usual white decomposed sanadin in irregular masses from 1/2 and less to 3/8 inches. The dip is to the east at varying angles the strike toward the sulphur hills looking back. The surface of the meadow is covered with small fragments of obsidian with the white specks. The meadow is 3/4 of a mile wide and extends up to the base of the mountains. The trail is in this valley.

Recrossed (east to northeast) to the camp through the timber. Distance seemed 2 to 2 1/2 miles. Struck the Canon 1/4 to 1/2 mile below Promontory Point. Made St. 2. The rock is a gray trachyte with very numerous sanadin, hard, laminated and apparently horizontal--whether this is bedding, I can't say. Cliffs very steep; took angles in sketch book of slopes 1 mile down. (see stkech book) Opposite is the breat brown wall which extends from opposite promontory point two miles or more down, rising higher at the top and growing deeper by the very rapid descent of the river. The upper half of the wall is a sheer cliff and has no angle. The dark horizontal face is scarred and seamed in a most remarkable manner, indicating there is a tendency to columnar structure. Great numbers of parallel crevices indicatin lamination of columns extend over the base of the wall. Opposite me the well made laminae, say 1 foot to 4 or 5 in width extend with a slight curve from top to bottom to the left and others at allangles, some bent into sweeping horizontal curves, while other parts of the cliff and expecially that

separating the groups are without the lines. I should think this a semicolumnar structure but for the fact that in places the laminae seem to be vertically parallel with the canon and when so show broad smooth faces. Such an area as this breaks off abruptly against the bas edges of the other outcropping laminae.

Down the middle portion of this scarred wall a cascade falls, from the very top. For 500 or 600 feet it is very steep. The thread of water sliding down the smooth, irregular groove made for itself,falling free at times. The lower half is on a steep slide between dense trees. The lower slopes here have the trees. At the lower end of this great wall the river bends to the east (see map) and afterwards turns again into its almost direct, straight course. At and above the bend and extending below is a series of hot springs and remarkably colored slides. The reds prevailing. Steam vents appear all along for a couple of miles.

On top of the Canon wall about one mile below and below the mouth of the creek that comes in from the left, a heavy series of stratified beds come in. They look like conglomerates and are slightly tipped up to the west.

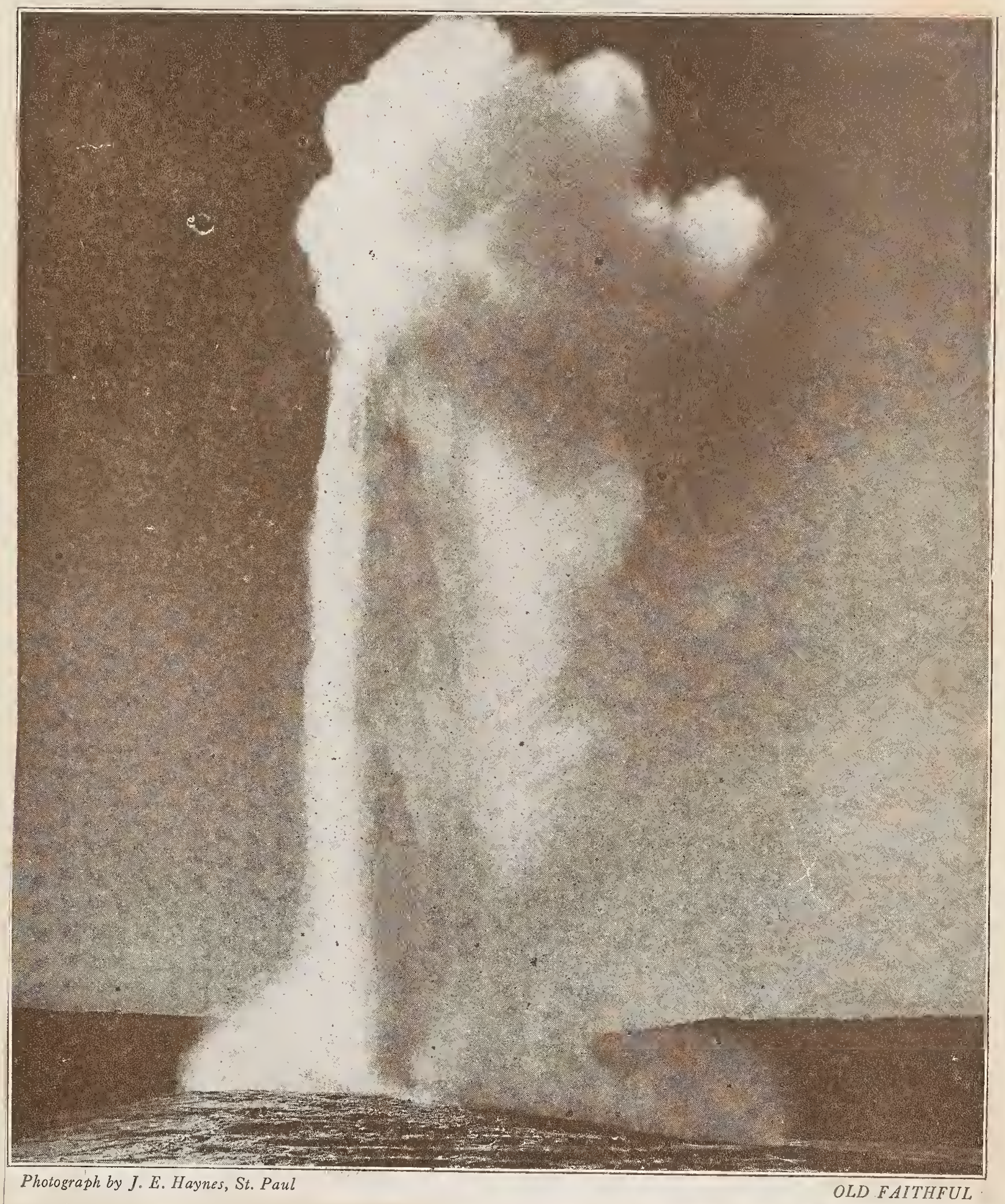
Found it too late to go farther and Washburn Creek seemed pretty deep in canon. Turned to the left and rode 6 or 8 miles through the forest along the base of a series of long table-like hills that lie along the south base of the mountains.

Found outcrops of trachyte and obsidian. They must be in horizontal or nearly horizontal beds.

End of notes

On October 18, 1878, the party reached Bozeman from Yellowstone Park and I returned at once to Washington, D. C.

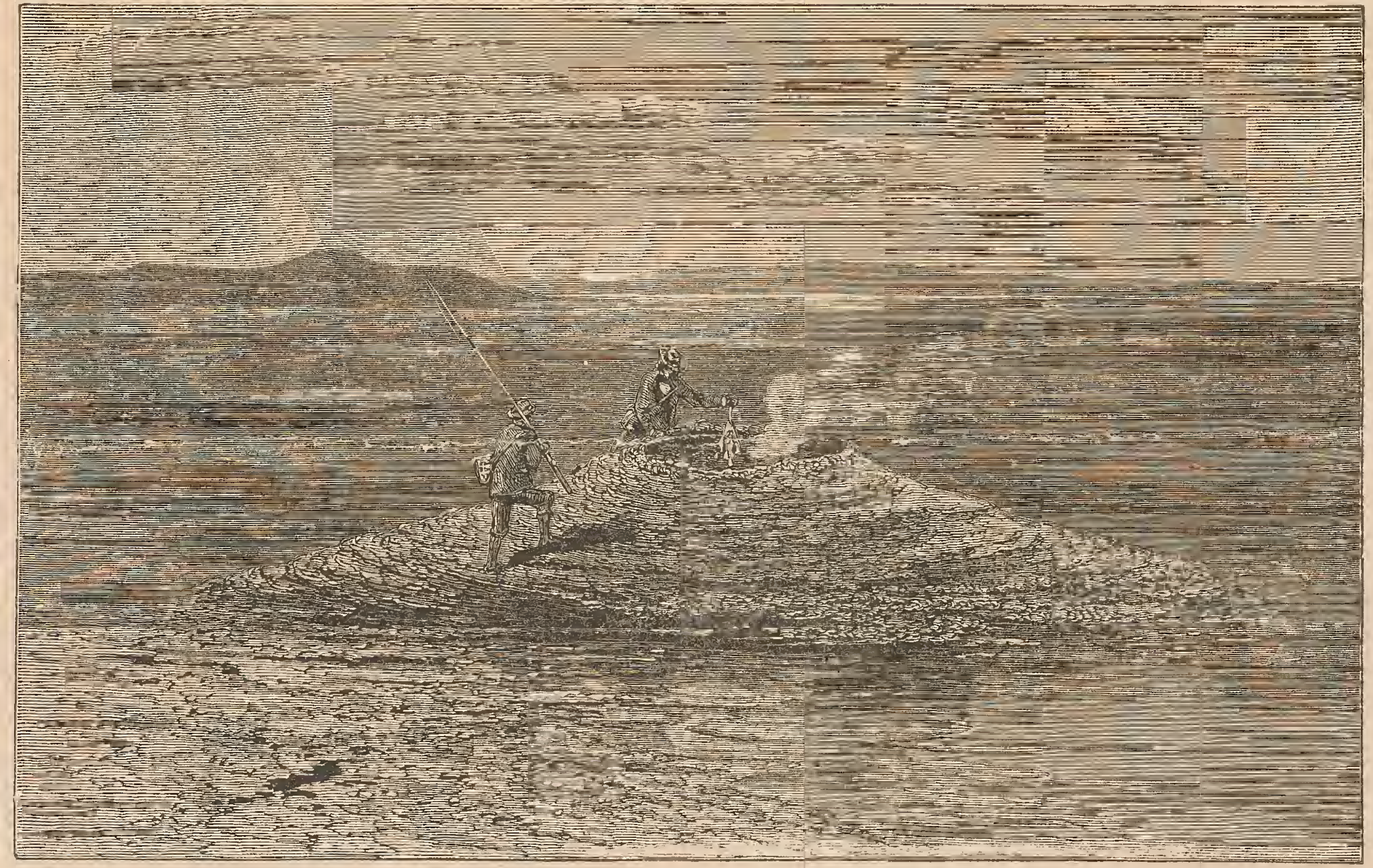
The remainder of the year was spent in preparing the Report on the geology of the park and in making drawings, sections, maps, etc. for all reports. This work was continued until the end of the fiscal year of 1879, when I started out for a year's study in Europe.



Photograph by J. E. Haynes, St. Paul

OLD FAITHFUL

PLATE XX.



Hot Spring Cone on west arm of Yellowstone lake.

AN INCIDENT IN THE EXPLORATION OF THE YELLOWSTONE

Taking leave of Mr. Jackson's party at the base of the Grand Teton, I made all haste to join Mr. Gannett's party in the Yellowstone Park. My agreement had been to meet the latter party at the head of Shoshone Lake on the 15th of July, but it was the 17th before I was able to leave Mr. Jackson's camp. Taking with me Mr. F. M. Amelung and Mr. S. D. Hovey, I ascended the valley of the Snake to the outlet of Jackson's Lake, making during the day some additional sketches.

The Grand Teton from the northwest is exceedingly fine, and Mount Moran, which rises from the west side of the lake, is a grand and interesting peak. The clouds obscured the summits of these peaks during the entire day and prevented satisfactory sketching.

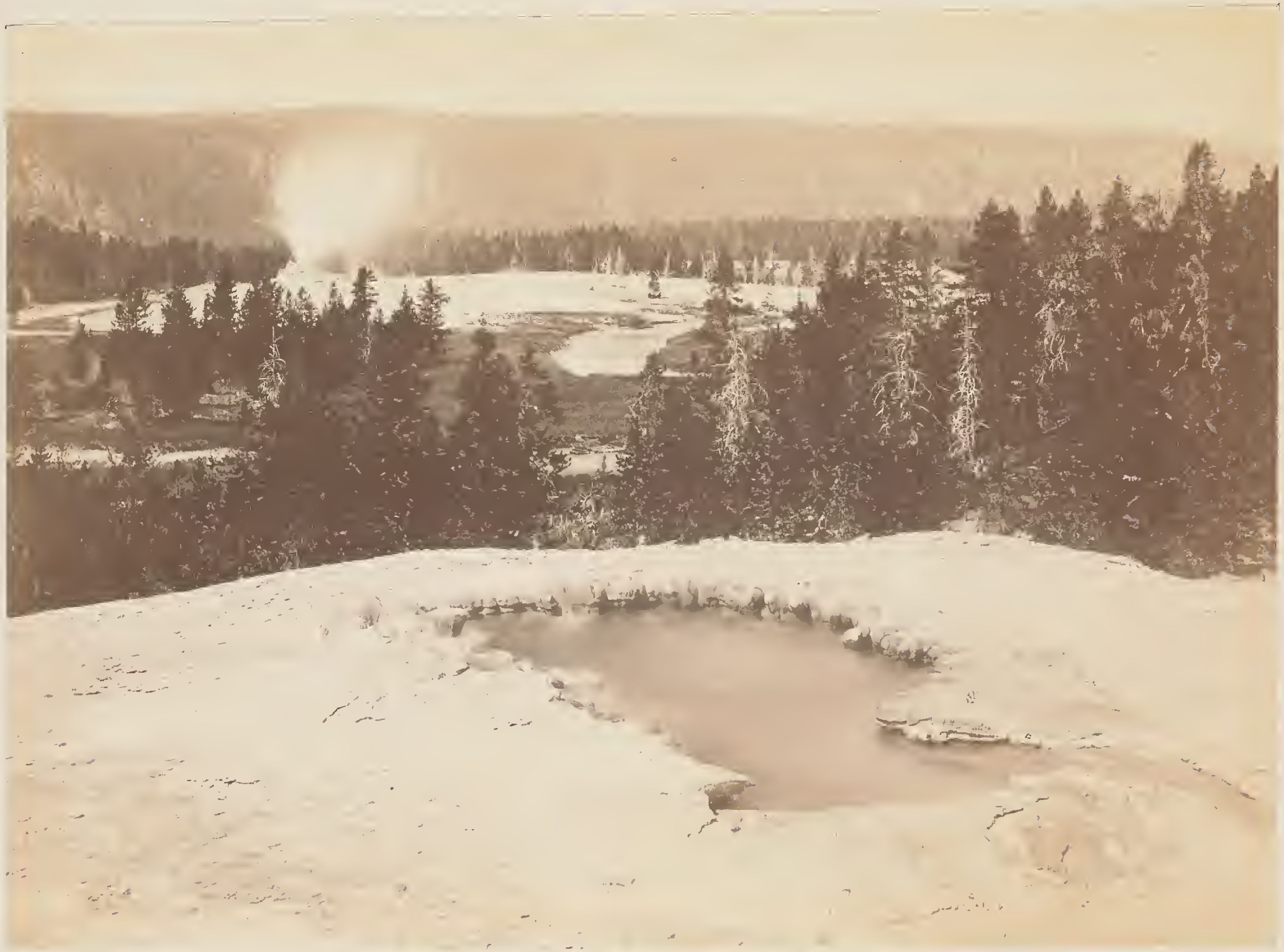
We were prevented from making long marches by the sickness of Mr. Hovey, and at the end of the second day were forced to go into camp quite early at the forks of the Snake. On the morning of the 20th we ascended the ridge between the two branches of the snake, and before noon reached the foot of Lewis Lake. Crossing the river at the point of its exit from the lake, we ascended the densely timbered ridge to the west and struck out to the northwest across a high timbered plateau. Late in the afternoon we came out upon an open valley through which flowed a large creek. On the north side of this valley lies a low wooded ridge, beyond which could be seen portions of Shoshone Lake. Crossing the valley and

still keeping to the northwest, we soon arrived at the southwest end of the lake, and after an hour's hard struggle with timber and swamps reached the camp of Mr. Gannett's party in the Geyser Basin. Dr. Peale was already at work making surveys of the Shoshone Geyser Basin. He had reached this point five days previously, in company with Mr. Gannett, and up to that time had been making geologic examinations in the southwestern part of the Park.

Mr. Gannett had left the main camp on the morning of the 19th, accompanied by Mr. Thomas Cooper, for the purpose of continuing his topographical work along the southern border of the Park, and it was thought by his companions in the main camp that on the 21st he would probably ascend some one of the higher summits of the Red Mountain Range. Wishing to join him as soon as possible, and feeling the importance of taking advantage of every opportunity to examine the geology of this part of the Park, I set out alone on the morning of the 21st, outfitted with a pair of blankets and provisions for two days. I felt confident that I could find him within that time, or, if otherwise, I should be able to spend the 22nd on Mount Sheridan and return to camp on the 23d. During the day I traveled steadily through the forest in a southeast direction, passing to the south of Shoshone Lake and touching the northeast corner of Lewis Lake. Twenty miles of travel brought me to the base of the mountains, and just before sundown I passed out of the timber, climbed up the steep west face and out upon one of the northern summits of the range. I had given up the idea of seeing

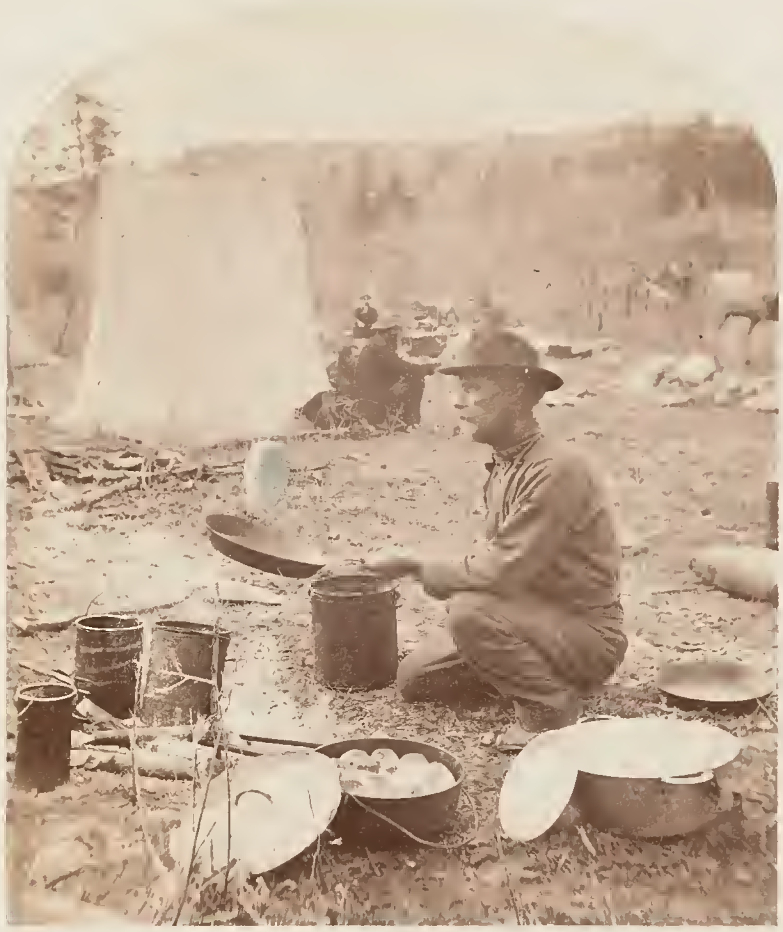
Mr. Gannett that day, and intended, after taking a glance around to determine on tomorrow's work, to descend to a little park that nestled at the west base and camp for the night. While looking about with my glass I noticed that a topographical monument had been built on the summit of Mount Sheridan, which lay about a mile to the east, and on looking a second time was both surprised and delighted to discover two men darkly outlined against the sky. A little later I joined my friends, and hastening down the precipitous northern face encamped with them at the head of Heart Lake.

(Report on the Geology of the Yellowstone National Park, by W. H. Holmes, 1879, pages 2 and 3.)



— Hot-Spring, Castle Geyser in the distance, 1872

Castle Geyser - Jackson 1872



JOHN RAYMOND
COOK
HAYDEN SURVEY. 1872
(Throwing a "flap jack")

YELLOWSTONE PARK, 1878

Ascent of Mount Holmes

On the morning of the 8th, Mr. Gannett and I set out to ascend the southern summit of the range, which is only inferior in elevation to Electric Peak, being 10,100 feet in height. This peak, or what we suppose to be this peak, has been spoken of occasionally by visitors as Mount Madison, but on what authority or for what reason it is not known. Mr. Gannett having first ascended it and determined its height and geographic position, proposed to give it the name of the writer, and by that name it will appear on his maps.

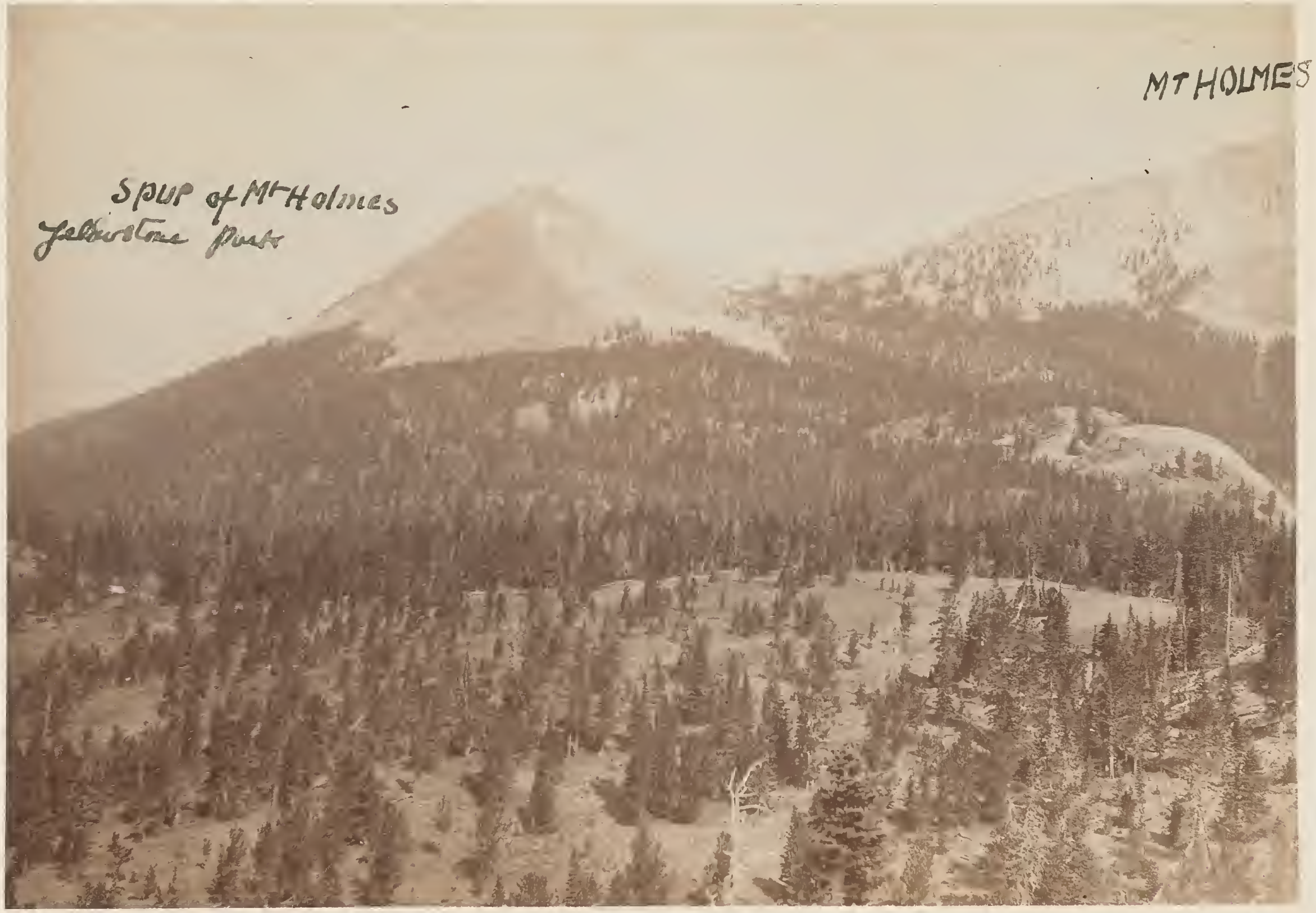
At an elevation of 8,000 feet we emerged from the forest and came out into a parked zone that skirts the lower slopes. Here there are fine upland pastures to which the wild game of the country resorts. Herds of elk were frequently encountered, and the country is literally cut up by their trails. At an elevation of 8,700 feet we reached an outcrop of reddish feldspathic granite. ... The ascent of a very steep declivity of some 500 feet brought us to the point of a narrow flat-topped promontory projecting to the southeast from the main peak. In the steep face of the promontory there are some 300 or 400 feet of dark gray laminated but much indurated limestones. They contain no recognizable fossils. These limestones form a well

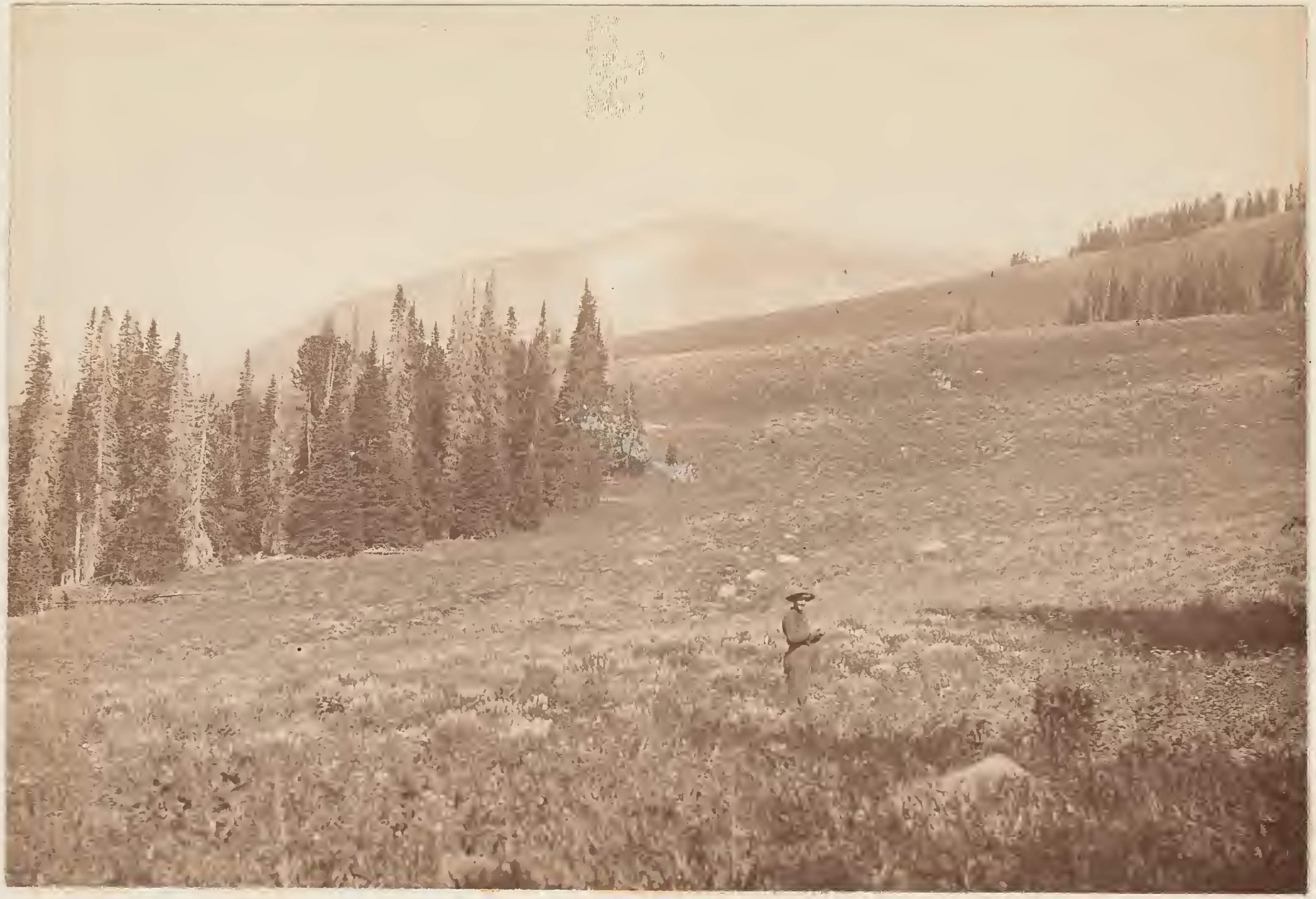
marked escarpment that extends around the base of the range, sinking with a dip of 2° to 5° to the level of the drift plain on the south slope.

From the promontory we passed up over heavy snow fields and up a sharp crest, and at an elevation of 10,200 feet reached a sharp conical point, a southeast outlier of Mount Holmes. Between this point and the main summit there is a depression of a few hundred feet. ...

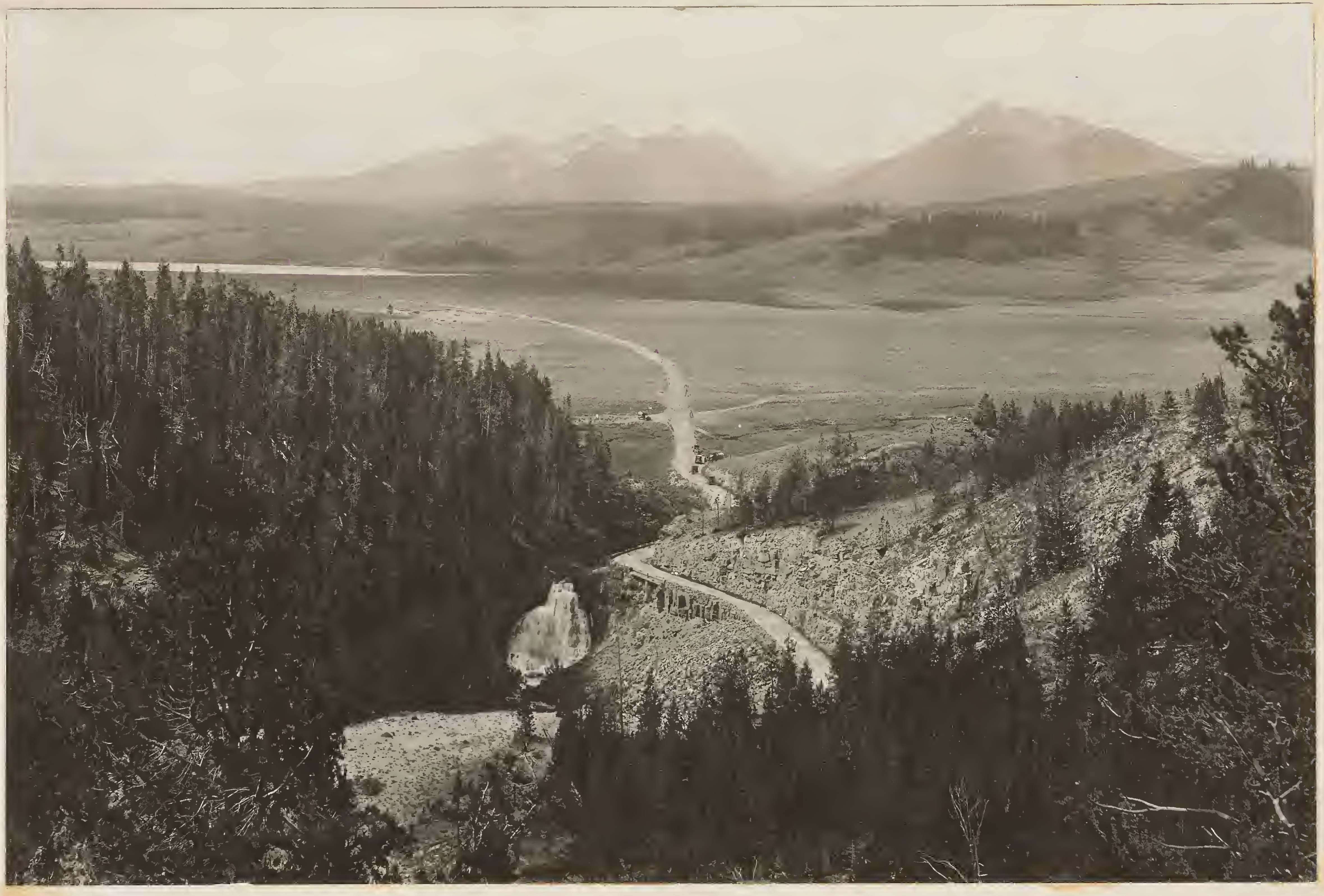
The day being exceedingly cold I had to refrain from prolonged examination as well as from the usual sketching. Topographically the peak is simple, but scenically rather imposing, occupying, as it does, the extreme point of the range and overlooking a grand sweep of low country bordering the Madison

(Report on the Geology of the Yellowstone National Park, by W. H. Holmes, 1878, page 23)


MT HOLMES
Spur of Mt Holmes
Yellowstone Park



Distant view of Mt Holmes, Gallatin Range or Madison range, 1878.



I was artist to the Hayden Survey of the Yellowstone in 1872 and geologist to the Survey in 1878. Henry Gannett, Topographer of the Expedition, with Dr. Hayden's approval, named the mountain peak shown at the left after me in 1878.

The falls of Gardiner River appear in the center of the view. The great Highway shown is of recent date, about 1920.

YELLOWSTONE PARK, 1878

Ascent of Mount Holmes

On the morning of the 8th, Mr. Gannett and I set out to ascend the southern summit of the Gallatin range, which is only inferior in elevation to Electric Peak, being 10,100 feet in height. This peak, or what we suppose to be this peak, has been spoken of occasionally by visitors as Mount Madison, but on what authority or for what reason it is not known. Mr. Gannett having first ascended it and determined its height and geographic position, proposed to give it the name of the writer, and by that name it will appear on his maps.

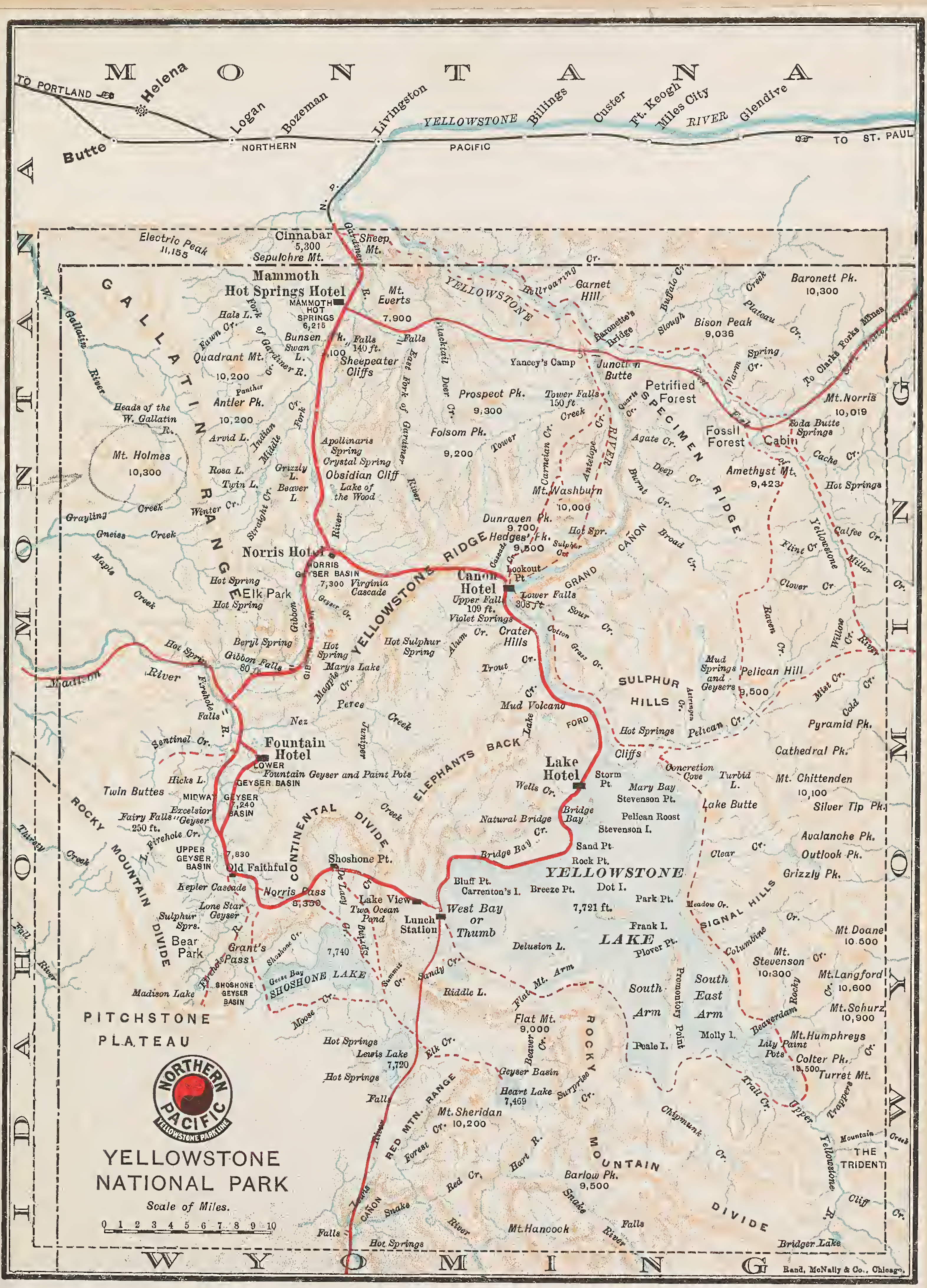
At an elevation of 8,000 feet we emerged from the forest and came out into a parked zone that skirts the lower slopes. Here there are fine upland pastures to which the wild game of the country resorts. Herds of elk were frequently encountered, and the country is literally cut up by their trails. At an elevation of 8,700 feet we reached an outcrop of reddish feldspathic granite. ... The ascent of a very steep declivity of some 500 feet brought us to the point of a narrow flat-topped promontory projecting to the southeast from the main peak. In the steep face of the promontory there are some 300 or 400 feet of dark gray laminated but much indurated limestones. They contain no recognizable fossils. These limestones form a well

marked escarpment that extends around the base of the range, sinking with a dip of 2^0 to 5^0 to the level of the drift plain on the south slope.

From the promontory we passed up over heavy snow fields and up a sharp crest, and at an elevation of 10,200 feet reached a sharp conical point, a southeast outlier of Mount Holmes. Between this point and the main summit there is a depression of a few hundred feet. ...

The day being exceedingly cold I had to refrain from prolonged examination as well as from the usual sketching. Topographically the peak is simple, but scenically rather imposing, occupying, as it does, the extreme point of the range and overlooking a grand sweep of low country bordering the Madison.

(Report on the Geology of the Yellowstone National Park, by W. H. Holmes, 1878, page 23)


MONTANA
IDAHO
WYOMING
TO PORTLAND
Helena
Butte
Logan
Bozeman
Livingston
NORTHERN PACIFIC
YELLOWSTONE RIVER
Billings
Custer
Ft. Keogh
Miles City
Glendive
TO ST. PAUL
N. P.
Electric Peak 11,155
Cinnabar 5,300
Sepulchre Mt.
Sheep Mt.
Mammoth Hot Springs Hotel
MAMMOTH HOT SPRINGS 6,215
Mt. Everts 7,900
GALLATIN RANGE
Quadrant Mt. 10,200
Antler Pk. 10,200
Mt. Holmes 10,300
Bunsen Pk.
Swan L.
Sheepeater Cliffs
Apollinaris Spring
Crystal Spring
Obsidian Cliff
Lake of the Wood
Beaver L.
Twin L.
Grizzly L.
Norris Hotel
NORRIS GEYSER BASIN 7,300
Virginia Cascade
Elk Park
Hot Spring
Gibbon Falls 80 ft.
Beryl Spring
Madison
River
Firehole Falls
Fountain Hotel
LOWER GEYSER BASIN
Fountain Geyser and Paint Pots
MIDWAY GEYSER BASIN 7,240
Excelsior Geyser
Fairy Falls 250 ft.
UPPER GEYSER BASIN 7,830
Old Faithful
Kepler Cascade
Lone Star Geyser
Norris Pass 8,350
Shoshone Pt.
Lake View
Two Ocean Pond
Lunch Station
West Bay or Thumb
SHOSHONE LAKE 7,740
SHOSHONE GEYSER BASIN
Grant's Pass
Bear Park
Madison Lake
PITCHSTONE PLATEAU
ROCKY MOUNTAIN DIVIDE
CONTINENTAL DIVIDE
ELEPHANTS BACK
YELLOWSTONE RIDGE
Yancey's Camp
Junction Butte
Garnet Hill
Baronette's Bridge
Tower Falls 150 ft.
Prospect Pk. 9,300
Folsom Pk. 9,200
Mt. Washburn 10,000
Dunraven Pk. 9,700
Hedges' Pk. 9,500
Cañon Hotel
Upper Falls 109 ft.
Lower Falls 308 ft.
Lookout Pt.
GRAND CAÑON
Violet Springs
Crater Hills
Hot Sulphur Spring
Mud Volcano
FORD
SULPHUR HILLS
Lake Hotel
Storm Pt.
Mary Bay
Stevenson Pt.
Pelican Roost
Stevenson I.
Bridge Bay
Natural Bridge
Sand Pt.
Rock Pt.
Bluff Pt.
Carrenton's I.
Breeze Pt.
Dot I.
Park Pt.
Frank I.
YELLOWSTONE LAKE 7,721 ft.
Plover Pt.
Delusion L.
South Arm
South East Arm
Promontory Point
Peale I.
Molly I.
Flat Mt. Arm
Flat Mt. 9,000
Riddle L.
Lewis Lake 7,720
Hot Springs
Heart Lake 7,469
Geyser Basin
Mt. Sheridan 10,200
RED MTN. RANGE
Barlow Pk. 9,500
Mt. Hancock
ROCKY MOUNTAIN DIVIDE
Lewis Cañon
Snake River
Falls
Petrified Forest
Fossil Forest
SPECIMEN RIDGE
Cabin
Amethyst Mt. 9,423
Baronett Pk. 10,300
Bison Peak 9,036
Mt. Norris 10,019
Soda Butte Springs
To Clarks Forks Mines
Mud Springs and Geysers
Pelican Hill 9,500
Pyramid Pk.
Cathedral Pk.
Concretion Cove
Turbid L.
Lake Butte
Mt. Chittenden 10,100
Silver Tip Pk.
Avalanche Pk.
Outlook Pk.
Grizzly Pk.
SIGNAL HILLS
Mt. Doane 10,500
Mt. Stevenson 10,300
Mt. Langford 10,600
Mt. Schurz 10,900
Mt. Humphreys
Lily Paint Pots
Colter Pk. 10,500
Turret Mt.
THE TRIDENT
Bridger Lake
Hot Springs
NORTHERN PACIFIC YELLOWSTONE PARK LINE
Rand, McNally & Co., Chicago.

YELLOWSTONE NATIONAL PARK

Scale of Miles.

0 1 2 3 4 5 6 7 8 9 10

Yellowstone Park, 1878.

(*From the American Naturalist, March*, 1881.)

GLACIAL PHENOMENA IN THE YELLOWSTONE PARK.[1]

BY WM. H. HOLMES.

IN common with very many of the more elevated districts of the Rocky mountains, the Park district presents a variety of glacial phenomena. In exploring the deep valleys of the higher ranges, the geologist is never surprised at encountering on all hands partially rounded masses of transp~~arent~~orted rock. These are pretty sure to be found on most of the old flood plains of the streams and often high up the sides of the valleys. They are frequently the only remaining records of ancient glaciers which have filled the valleys at different stages of their erosion. The glaciation of rocks *in situ*, in the narrow gorges, also bears testimony to the former existence of glaciers. Loose boulders are doubtless, in many cases, carried from their original beds by the force torrents, and not infrequently reach places very far distant from their original station by a gradual creeping or sliding movement —the result of undermining or yielding of the soil beneath. It is, therefore, far from safe to conclude that wherever erratic rocks are found, glaciers have formerly existed, especially in cases where these rocks may have had their origin in surrounding highlands, or even quite distant mountains of very considerable elevation.

In a region like this, however, there is every reason to suppose that glaciers once existed on a very extensive scale. The park, with the great continental water-shed that surrounds it, forms one of the grandest masses of highland in the United States.

In early quaternary times, as now—if there have been no important changes of level in the meantime—the general level of the park district exceeded eight thousand feet, and the broad areas of mountainous country on the west, north and east, represent a former general elevation of twelve thousand feet or more.

---

[1] Extracted from the unpublished Report of the U. S. Geol. Survey of the Territories. Exploration of 1878.

Glaciers exist now in the neighboring Wind River and Teton mountains at elevations much below twelve thousand feet, and in the midst of glacial times descended in immense sheets to four thousand and five thousand feet. It would, therefore, be a matter of surprise if traces of glaciers were not found here, not only in the high valleys, but upon the surfaces of the broad plateaus of the park. There is, however, a singular absence of well defined glacial moraines. The tens of thousands of granite boulders that occur on both sides of the Yellowstone valley, from Cinnabar mountain to the north base of Amethyst mountain, generally lie upon the smooth surface of the flood planes of the river, or upon low ridges of alluvial drift. The significance of this fact may be that the transporting glaciers existed in the earlier stages of the erosion of the valley, and that the morainal ridges have been destroyed by the river as it oscillated from side to side in the succeeding stages of its descent from the plateau level to its present bed. These great boulders would, in such a case, be the more durable masses of the moraines stranded on the various flood planes for want of water power to transport them.

When we come to search for the source of the granite, we are led to observe an interesting fact. The only bodies of granite rock within the limits of this valley are found either on the north side or on the bottom at no considerable elevation above the river. But the erratic masses occur to a great extent on the south side of the valley and at all elevations. In the vicinity of Mt. Evarts they reach the upper surface of the plateau more than two thousand feet above the river bed. It is evident that these masses of granite were transported to their present resting places either before the valley existed or that the ice streams were so deep as to fill the valley to the brim and thus carry and strand them. Still it is a question whether in the latter case these boulders would ever reach their positions on the south side—supposing the glaciers to follow the course of the valley—as they would have to accomplish the feat of crossing the whole width of the glacier as a boat would cross a ferry. This could really only occur in case there should be such an increase in the masses of ice descending from the highlands to the north, as to completely fill the valley, sweep across its course and overspread the broad table-land to the south. This table-land I have named the Park plateau; it is wholly volcanic, and is separated from the base of the granite highlands on the north, by the valley of the Yellowstone proper, and by the East fork, its geologic as well as topographic continuation. It extends, with but few interruptions, one hundred miles to the south. We are here led to inquire whether or not there are evidences of former glaciers on this plateau. Such evidences do exist, but they are certainly not such as we might expect. Instead of well-defined moraines, an area dotted by erratic boulders and broad expanses of polished surfaces as in the Wind River and Teton mountains, we find only a few rocks other than those that may have been derived from the plateau itself. It should be remarked, however, in this connection, that the soft rhyolites which form the greater part of the plateau, would not retain glacial markings for any considerable length of time.

An occasional small block of granite indeed is found, and sometimes at unexpected levels, as on the slopes of the Washburn mountains many hundreds of feet above the general level of the plateau. A very few have been observed beyond Mt. Washburn, on the south side. The most remarkable example of these is a boulder resting upon the brink of the grand cañon, about a mile and a half below the great falls and nearly eighteen miles from the northern border of the plateau.

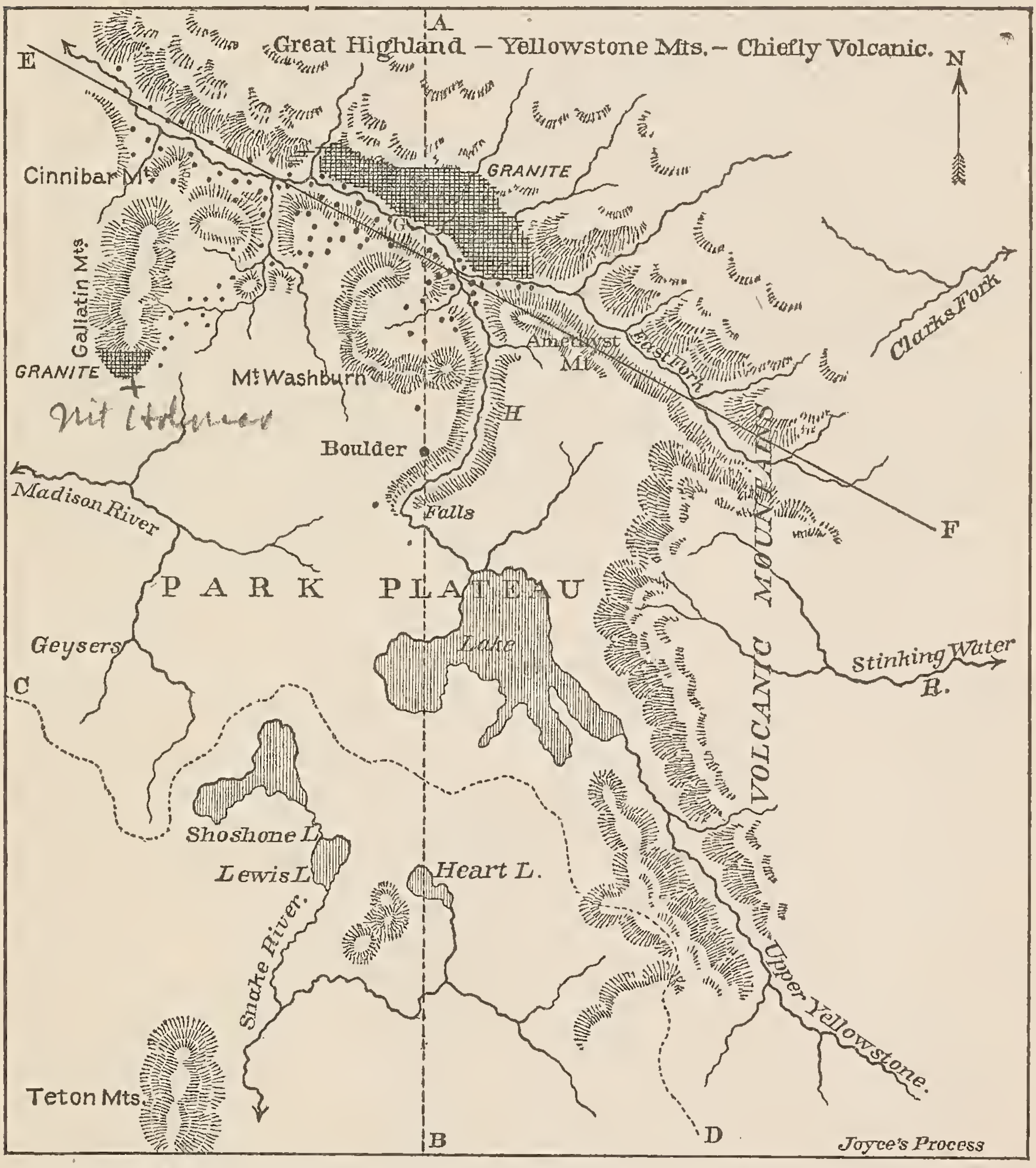
On a stormy day in December I undertook to meander the grand cañon from the falls to the base of Mt. Washburn, and during a storm of rain and sleet took shelter under the overhanging edge of a great rock in the dense timber. Considerably to my surprise I discovered it to be a very compact coarsely crystalline feldspathic granite. In shape it is somewhat rectangular, the edges for the most part sharp and unworn, the result of spawling by the heat of forest fires. In cubical dimensions it will probably exceed two thousand feet. It is within a stone's throw of the brink of the cañon and rests upon a sheet or a series of sheets of rhyolite, not less than one thousand feet in thickness, as may easily be determined by an examination of the section exposed in the cañon walls below.

In seeking the possible source of this rock we naturally turn to the south, towards the sources of the Yellowstone. The plateau along the river's course and around the lake is totally volcanic.

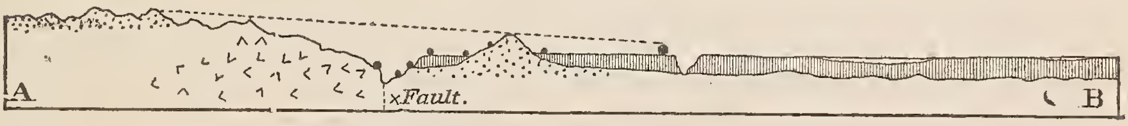
The great ranges to the east and south of the lake are not known to contain a single exposure of crystalline rock. That there are no such formations in the whole drainage of the Upper Yellowstone is established by the fact of the almost total absence of granite pebbles on the shores of the lake or in the bed of the river. The home of this wanderer must be sought elsewhere. To the north, beyond the valley of the third cañon and the East fork, lies the granite highland previously mentioned. To the north-west, beyond the valley of Gardiner river, at the southern end of the Gallatin mountains, is another exposure of granite at an elevation sufficient to have given origin to it. The distance in either case is upwards of twenty miles. From the great falls the river descends in a northerly direction until it strikes the base of the granite highland; here it unites with the East fork and turns to the west along the south base of that highland, following the line of the great displacement until it passes the granite gateway of the second cañon (see accompanying map). To reach its present position from the northern locality, the boulder must cross the course of the great valley of the East fork and the third cañon and ascend the river, as it now exists, a distance of twenty miles, avoiding on its way, by a circuitous route, the intervening Washburn range and the opposing mass of Amethyst mountain. If from the Gallatin mountains, it must first have crossed the valley of the upper Gardiner river and afterwards a considerable spur of the Washburn mountains—a journey of twenty miles south-east. Notwithstanding the fact that this pathway would, with anything like the present topography, seem to present fewer obstacles to the advance of a glacier than that from the north, I cannot regard it as at all probable that this was its course. The mass of the Gallatin mountains is not great. Glaciers originating in its short abrupt valleys would have no great longitudinal extent, and would probably advance no farther than the deepest part of the valley that lies along their immediate base.

The great ranges to the north are of sufficient extent to give birth to ice rivers of the grandest proportions. The present distribution of the erratic fragments of granite tends to strengthen the impression that they had their origin in the north. If this be admitted, it becomes at once clear that the erosion of the grand cañon has been accomplished since the close of the glacial period, or at least that a second erosion has taken place if a cañon did exist prior to the glacial epoch.

That a very profound erosion had taken place along the course of the cañon at a very early date is proved by the fact that during the rhyolitic period as well as the basaltic and andesitic, there were cañons almost as deep as the present one, into which the coulées cascaded. At one spot near the northern base of Mt. Washburn the section of a fossil river is exposed, more than


A
Great Highland. – Yellowstone Mts. – Chiefly Volcanic.
N
E
Cinnibar Mt.
GRANITE
G
Gallatin Mts.
GRANITE
Mt. Washburn
Mt Holmes
Amethyst Mt.
East Fork
Clarks Fork
H
Boulder
Falls
F
Madison River
PARK PLATEAU
Lake
VOLCANIC MOUNTAINS
Stinking Water R.
Geysers
C
Shoshone L.
Lewis L.
Heart L.
Snake River
Upper Yellowstone.
Teton Mts.
B
D
Joyce's Process

A–B, Section line. C–D, Ocean divide. E–F, Line of Great Fault. G, Third cañon. H, Grand cañon. The black dots indicate the position of granite boulders.

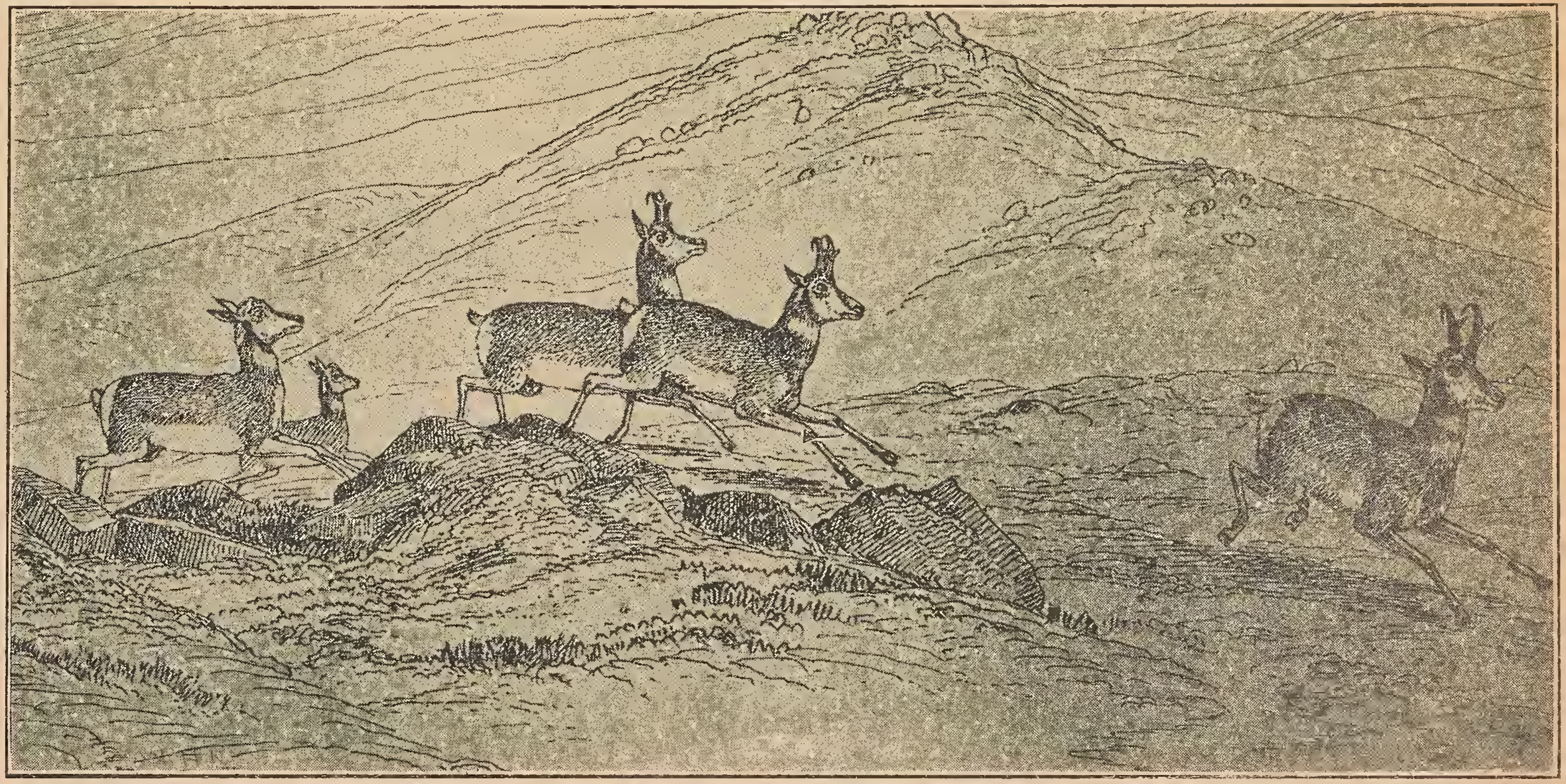


Glacial Phenomena of the Yellowstone Park.

half way down the cañon wall, the bed of which has been cast in andesitic lava, and the volume of whose water discharge is recorded in pumice stone.

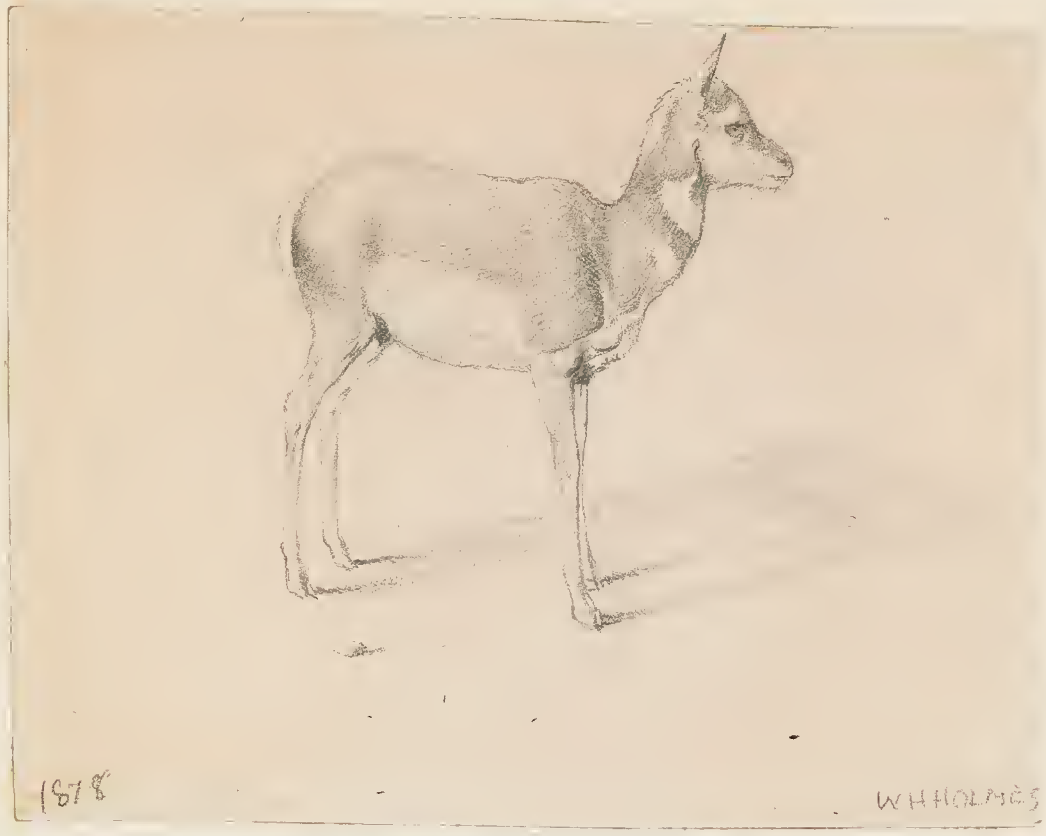
These events probably belong, however, to miocene and pliocene times, and the topography of this region in those periods—the course of the rivers and the configuration of the country must for the most part remain unknown.

Topographic changes of quarternary times are, however, much more easily traced. The mass of glacial ice necessary to carry the great boulder described above to its present resting place would change the whole drainage of the park. The waters of the Upper Yellowstone and of the numerous tributaries of the lake would be forced across the low continental divide to the south and become tributary to Snake river and the Pacific, or otherwise to some of the western branches of the Missouri.



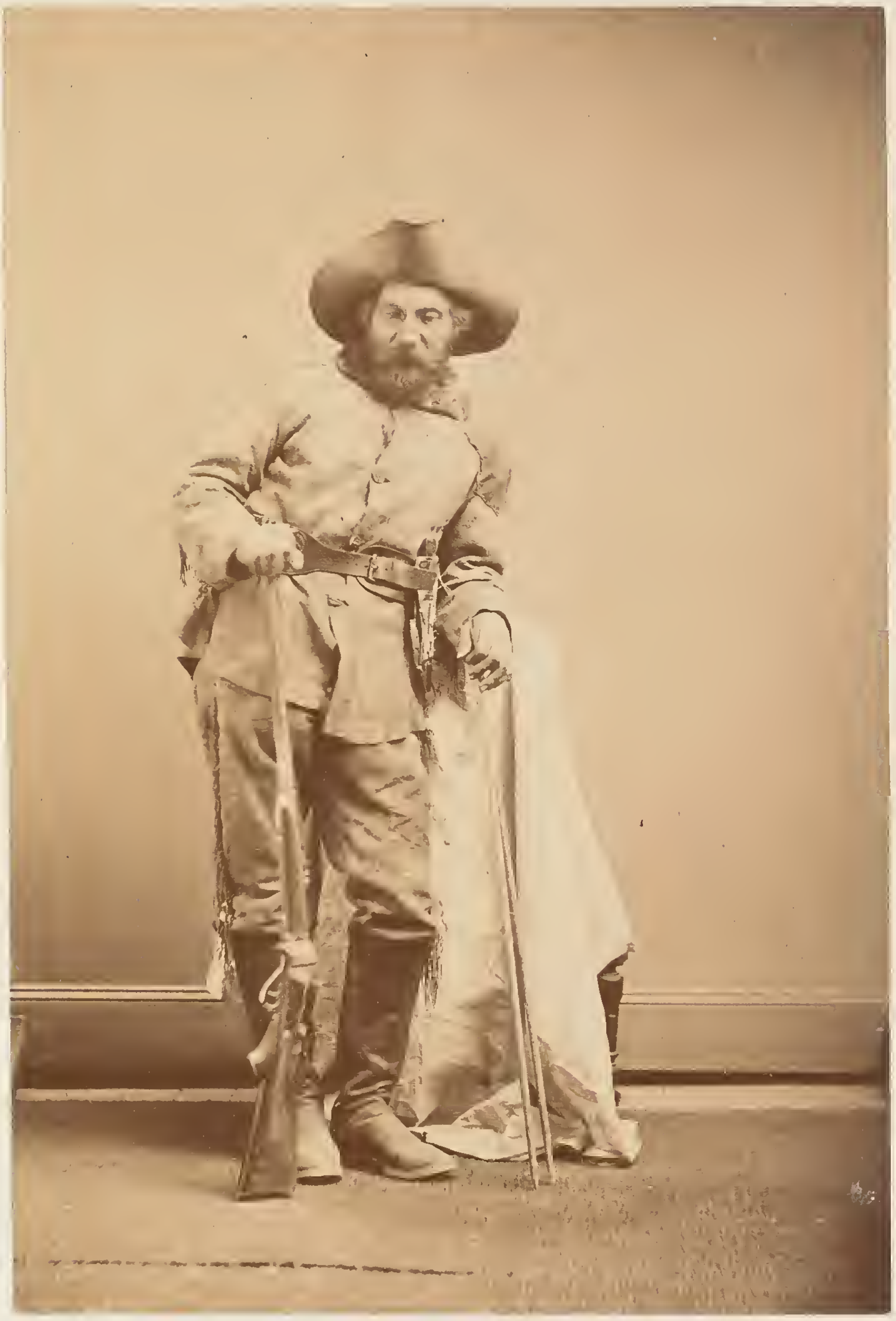
THOSE LIVING OF THE PIONEER SURVEYORS OF THE "TERRITORIES" WILL RECALL THIS SCENE

My own pen drawing


1878
W H HOLMES

Innocence, study of a young antelope

attention - study of a mule



Harry Yount, Hunter
Hayden Party 1

See his letter to me
[illegible]

1878

Letter from Harry Yount - an
very good hunter for the expeditions
of 1873-4-5. see his portrait.

Rawlins April 6. 78

Dear
Mr Homes i came in
Rawlins i come to get Some
grub and will Start to fore the
Sweet water way I have found gold
one the Sweet water but I
haint found the Pay Stick yet
you write to Rawlins and
lee me when you will be
out I will Send you Some
Skeches frome ute Indian
Artis I think you will like
them very much the
utes has bine one the
Sweet water all winter
thuir villig cloce by my
Camp
they had good time
Hunting Buffalo

Douglas Big chey

O-lel Jaack and
Raine Bow and Aertatel
they have made a
trety Arhephos

the greene grass is thee
inches hy ame the Sweet
Water valey
Ever thing is lovley
and the goos has come
Plenty Elk Black and Antale
mountain Sheep

Harry Yount

1878

Page 1 last

Mt Holmes. Gallatin Range - see photo

knowledge of my connection with the Survey. This mountain is in plain sight from the geyser basin and is 10,300 feet in height. (See accompanying photograph and the pencil drawing by W. H. Jackson in my 80th Anniversary Letter Book in the National Gallery library. See also map and panoramic views contained in the 1878 report of the Survey). Another honor, which ordinarily escapes attention is the naming after me of a fossil shell, Unio Holmes ianus by Professor White, Paleontologist of the Survey.

The narrative of the season's operations, full of interest to every one concerned, is best recorded in my diary, a copy of which follows. Associated with this day by day story are copies of my geological report as printed in the Survey Annual for this year. Separate accounts are given of my observations on the glacial phenomina of the Park, the fossil forrests of the Park and the Indian implements of obsidian distributed widely over the whole region.

My original field notes in the form of a diary, were too voluminous to be preserved and have been destroyed. The larger sketch books filled with panoramic and other views and drawings have been retained with the records of the Survey. A copy of my diary for the season is contained in a separate envelope and a duplicate copy has been sent to Mr. Albright, Superintendent of the Park.

EXTRACTS FROM THE SMITHSONIAN REPORT FOR 1878
RELATING TO THE WORK OF W. H. HOLMES ON THE HAYDEN SURVEY FOR 1878.

"Mr. W. H. Holmes acted as geologist to the second division. The first month of the season he was with the fourth division, which proceeded from Point of Rocks Station northward, along the west side of the Wind River Mountains, and up the Snake River Valley to the Yellowstone Park, where he joined the second division. In the mean time he was engaged in making sketches, panoramic views, and geological sections of the intermediate country, all of which will prove of the highest importance in illustrating the geological structure of this most interesting and complicated region." (Page 66)

"Mr. W. H. Holmes was detailed as geologist of this division, while to Dr. A. C. Peale was intrusted the study of the hot springs and geysers, Mr. Gannett undertaking the secondary triangulation and topography of the park, and his assistant, Mr. J. E. Mushbach, the detailed survey of the geyser basins and other groups of springs.

"The party left Granger Station, Wyo., on July 28; drove up Green River to the head of the basin; thence down the rugged defile of Hoback's River to the Snake, and up the Snake to its forks at the south boundary of the Yellowstone Park.

"Turning westward at this point, they spent a few days in surveying Fall River and its affluents, then returned to the Shoshone Geyser Basin at the west end of Shoshone Lake. Here the party was

joined by Mr. Holmes, who up to that time had accompanied Dr. Hayden in the Wind River and Téton Mountains.

"Leaving the body of the party in permanent camp at the Shoshone Geyser Basin, Messrs. Holmes and Gannett visited the Red Mountains and the country south of Yellowstone Lake. On their return from this trip, which occupied a week, the party, re-enforced by that of Mr. Jackson, moved across the divide to the Upper Geyser Basin, near the head of the Madison (Fire Hole) River." (Page 73)

EXTRACTS FROM DR. HAYDEN'S REPORT FOR 1878
RELATING TO THE FIELD WORK OF W.H.HOLMES FOR THAT YEAR.

"The most notable feature of the work of Mr. Holmes for 1878 was his connection with the Survey of the Yellowstone Park on which he acted as geologist and made an extended Report on the Geology of the Park which is included in the 1878 report of the Survey of the Territories." It occupies pages 1 to 57 of that report.

"To the division of the Survey in charge of Mr. Henry Gannett was intrusted the work of making a specially-detailed geological and geographical survey of the Yellowstone National Park. The party was divided into two sections for the prosecution of this work; one section, consisting essentially of Mr. Gannett, topographer, and Mr. W. H. Holmes, geologist, made the general survey of the park, while the other, consisting of Dr. A. C. Peale and Mr. J. E. Mushbach, were occupied in making detailed studies and maps of the geyser and hot-spring localities, a work of the greatest interest and value to the scientific world."

"In the meantime Mr. Holmes made sketches covering every square mile of the Park, an area of 3,500 square miles. In such minute detail was the work done that the economic resources, as well as all the minor features of the geology, can be laid down on a map on a scale of one mile to an inch with the greatest care and minuteness. The great variety of forms which the mountains

in and around the park assume can be presented to the eye by panoramic views with wonderful distinctness." (Page XV)

"The editorial work has been under the supervision of W. H. Holmes, who has also had general charge of the business of the Survey in Washington for the last two years. He has bestowed much time and labor upon the preparation and revision of illustrations as well as upon other details of the work." (Page XVIII, 1878 Report)

In addition to my report on the geology of the Park, I made separate reports on the fossil forests of the Park and on the obsidian implements left by the Indians at many points; these are privately published. See Bibliography, Vol. I.

(52)

AUTHOR'S EDITION.

DEPARTMENT OF THE INTERIOR.
UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY.
F. V. HAYDEN, U. S. Geologist-in-Charge.

FOSSIL FORESTS
OF THE
VOLCANIC TERTIARY FORMATIONS
OF THE
YELLOWSTONE NATIONAL PARK.

BY

W. H. HOLMES.

EXTRACTED FROM THE BULLETIN OF THE SURVEY, VOL. V, NO. 1.

WASHINGTON, February 28, 1879.

Art. VII.—Fossil Forests of the Volcanic Tertiary Formations of the Yellowstone National Park.

By W. H. Holmes.

The prevalence of extraordinary volcanic activity throughout that part of the Tertiary age represented by the post-Cretaceous rocks of the Yellowstone region has given to them a most unique and interesting character. So destitute of animal remains are they, and so unlike the formations of the age in other parts of the Rocky Mountain region, that, notwithstanding the frequent visits of geologists, no divisions into sub-groups have been made, and no more definite appellation for the whole group has been found than the "*Volcanic Tertiary*"; this name, although so general, is singularly appropriate, and, in the absence of specific determinations, may be used to designate the entire group of Tertiary strata in the Park district.

It is not my intention in this brief notice to attempt the classification or correlation of these strata, but to give a brief account of some very remarkable features brought to light by last year's explorations.

In the valley of the East Fork of the Yellowstone River, where this peculiar group of rocks is typically developed, they have a thickness of upwards of 5,000 feet. The prevailing materials which enter into their composition are fragmentary volcanic products, which have been apparently redistributed by water, and now form breccias, conglomerates, and sandstones. It has been noticed by nearly all visitors that these strata contain a great abundance of silicified wood, and in a few cases trunks of trees *in situ* have been reported. The lowest observed occurrence of the strata of this group is in the valley of the main Yellowstone, between the first and second cañons, at an elevation of about 5,000 feet above the sea. They are also finely developed in the Gallatin Range to the west of this valley, and about the sources of Cañon and Boulder Creeks reach a thickness of between 3,000 and 4,000 feet. At a number of points covering this entire thickness, masses of silicified wood occur, and near the divide at the head of Boulder Creek silicified trunks, many feet in height, and of gigantic proportions, stand in the identical strata in which they grew, the crumbling conglomerates having withered away, leaving them standing upright along the steep slopes of the mountain. In general, these strata are horizontal. The bedding is often heavy, and in places not well marked; sub-aërial volcanic deposits apparently alternate to some extent with the sub-aqueous.

Three miles above the mouth of Gardiner's River, in similar strata, there are a number of silicified trunks *in situ*, most of which occur in a stratum of sandstone that lies directly upon the eroded surface of a series of mica-schists that belong to the metamorphic range north of the Yellowstone River. This is at an elevation of 6,000 feet.

On the south side of the third cañon, opposite the mouth of Hell Roaring Creek, is a massive promontory composed of conglomerates, in which are very numerous intercalated beds of sandstones and shales. In the steeper faces of this promontory, many fine trunks are exposed. In 1872, Dr. Peale obtained some very perfect specimens of fossil leaves from these beds, on the Elk Creek side, which were determined by Professor Lesquereux to be of Eocene types. The walls of the cañon in the vicinity of Hell Roaring Creek are formed of the same series of rocks, which occur also at a number of points on the river between Elk Creek and the lower falls.

In the valley of the East Fork, the sedimentary formations of the Volcanic Tertiary reach their maximum developement. Here they rest upon the unevenly eroded surfaces of the palæozoic and granite rocks, and form a great part of the mountain ranges that enclose the valley. They are horizontal and apparently conformable throughout the entire thickness of 5,500 feet. The greater part of this immense group of strata is filled with the silicified remains of a multitude of forests.

The section given in the accompanying plate occurs in the north face of Amethyst Mountain, opposite the valley of Soda Butte Creek, and includes upwards of 2,000 feet of strata. The bed of the river is at an elevation of 6,700 feet above the sea, and the summit of Amethyst Mountain, 9,400. On the north side of the valley, near the mouth of Soda Butte Creek, there are between 300 and 400 feet of Carboniferous strata exposed along the base of the mountain slope. On the south side, occasional ledges of limestone appear above the detrital deposits. Thin sheets of basalt cover the flat part of the valley, which is here less than a mile in width.

The north face of Amethyst Mountain does not present as abrupt a profile as that given in the section, the middle part only being so precipitous. At the base and top there are comparatively gentle slopes; nevertheless, the actual stratigraphical conditions are truthfully represented.

As we ride up the trail that meanders the smooth river-bottom, we have but to turn our attention to the cliffs on the right hand to discover a multitude of the bleached trunks of the ancient forests. In the steeper middle portion of the mountain face, rows of upright trunks stand out on the ledges like the columns of a ruined temple. On the more gentle slopes farther down, but where it is still too steep to support vegetation, save a few pines, the petrified trunks fairly cover the surface, and were at first supposed by us to be the shattered remains of a recent forest.

In ascending one of the steep spurs that project from the main wall, the strata were found to consist, toward the base, of shales and fine-

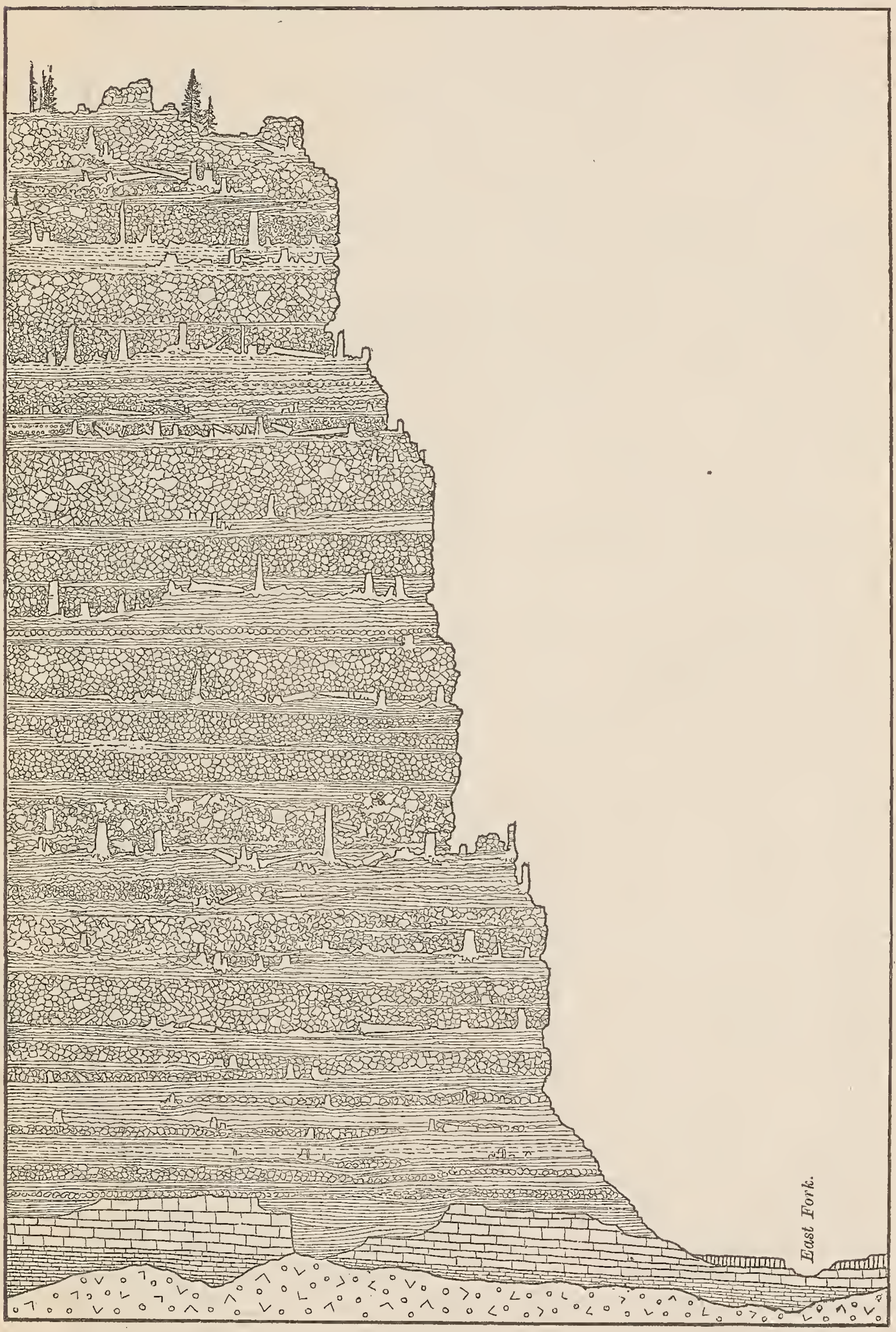


FIG. 1.—Section in the north face of Amethyst Mountain.

grained sandstones. Higher up conglomerates occur, and still higher coarse conglomerates and breccias prevail. Interbedded with the massive, irregular beds of the latter rocks are always thin layers of sandstones and shales. The sandstones are fine-grained, thinly bedded, and contain more or less tufaceous material. Their prevailing color is greenish and greenish-gray. They are apparently composed chiefly of materials derived directly or indirectly from volcanic sources. In no case are pebbles of quartz or other granitic constituents found in either the sandstones or conglomerates.

The exposures of strata in the first three or four hundred feet at the base are not good, and but few of the silicified trunks appear above the covering of vegetation. At the height of 500 feet, the occurrences become very numerous, and the great size and fine state of preservation of many of the trunks was a matter of much surprise. Prostrate trunks, 50 and 60 feet in length, are of frequent occurrence, and not a few of these are as much as 5 or 6 feet in diameter.

The standing trunks are generally rather short, the degradation of the compact enclosing strata being so slow that the brittle trunks break down almost as fast as they are exposed. In many cases the roots are exposed, and may be seen penetrating the now solid rock with all the original ramifications One upright trunk, of gigantic proportions, rises from the enclosing strata to the height of twelve feet. By careful measurement it was found to be ten feet in diameter, and as there is nothing to indicate to what part of the tree the exposed section belongs, the roots may be far below the surface, and we are free to imagine that there is buried here a worthy predecessor of the giant *Sequoias* of California. Although the trunk is hollow, and partly broken down on one side, the woody structure is perfectly preserved, the grain is straight, and the circles of growth distinctly marked. The bark, which still remains on the firmer parts, is four inches thick, and retains perfectly the original deeply lined outer surface. Specimens of the wood and bark were collected, but no microscopic examinations have been made. It is clear, however, that the tree was not a conifer. The strata which enclose this trunk are chiefly fine-grained greenish sandstones, indurated clays, and moderately coarse conglomerates. They have been built around it as it stood in comparatively shallow, but doubtless quiet waters. As would naturally be expected, these strata contain many vegetable remains: branches, rootlets, fruits, and leaves are extensively enclosed. One stratum of sandstone that occupies a horizon nearly on a level with the present top of the giant tree contains a great variety of the most perfectly preserved leaves. Such specimens as we were able to bring away with us have been submitted to Professor Leo Lesquereux for identification. They are found by him to belong to the Lower Pliocene or Upper Miocene, and correspond in a number of their species with the Chalk Bluffs specimens of Professor Whitney. They include—

Aralia Whitneyi,
Magnolia lanceolata,

Laurus canariensis,
Tilia (new sp.),
Fraxinus (new sp.),
Diospyros (new sp.),
Cornus (new sp.),
Pteris (new sp.),
Alnus (new sp.), and a
Fern (new sp.).

It will be observed that most of these species are new, which was also the case with the collection of Professor Whitney. It is also worthy of remark that none of the genera are identical with those of the Elk Creek locality previously mentioned. The stratigraphical relations of the two localities cannot easily be made out, as they are separated by fifteen miles of broken country in which the strata are obscured by igneous flows and Quaternary drift. The Elk Creek strata are lower by fully one thousand feet.

As far above the leaf-bearing horizon as I was able to ascend, the silicified trunks were very numerous and well preserved, and, by the aid of a field-glass, others could be detected in all parts of the cliff to the highest stratum.

At another point, nearly a mile farther east, I climbed the rugged walls of the mountain for the purpose of examining a number of large trees that were visible from below. Trunks and fragments of trunks were found in great numbers and in all conceivable positions. In most cases the woody structure is well preserved, the trunks have a tendency to break in sections, and on the exposed ends the lines of growth, from center to circumference, can be counted with ease. In many cases the wood is quite completely opalized or agatized, and such cavities as existed in the decayed trunks are filled with beautiful crystals of quartz and calcite. Our party was so fortunate as to procure some very handsome specimens of amethyst and ferruginous quartz. It is a matter worthy of observation that nearly all of the beautiful crystals that occur so plentifully in this region have been formed in the hollows of silicified trees. The same fact has been noticed in regard to similar crystals in many parts of the West, and notably in the case of the smoky quartz of the Pike's Peak region in Colorado.

The silicifying agents have been so unusually active in the strata of the Volcanic Tertiary that not only are all organic remains thoroughly silicified, but all cavities in the loosely bedded rocks and all fracture-lines in the strata are filled with chalcedony or other forms of quartz.

On reaching the heavily bedded conglomerates of the upper third of the cliff, I found the trees still more perfectly preserved. Many of the trunks are twenty and thirty feet in height. Their roots are in most cases imbedded in the layers of finer-grained materials, in which they grew, while the battered and branchless trunks are encased in the coarse conglomerates and breccias. These latter rocks are composed chiefly of basaltic fragments, many of which are of great size; there is, however, always enough tufaceous and other fine-grained material to fill in the interstices and act as a cement. These beds are massive and irregular, and seem to have accumulated too fast to be thoroughly redistributed by the waters. Only the stronger trees of the forest seem to have withstood the fierce storms of rocks that must have prevailed at the period of their entombment, as the smaller trunks and branches are prostrate or totally destroyed. In most cases where upright trunks penetrate the entire thickness of an enclosing bed, the tops may be seen to terminate with the upper surface of that bed, as if causes had acted at the beginning of the deposition of the succeeding stratum to plane down the irregularities of the old surface. In due course of time, this succeeding stratum produced its growth of forest, which followed its many predecessors into the subterranean depths, and in its turn was buried by the rapidly accumulating conglomerates. This remarkable alternation of events seems, in a general way, to have been kept up from the beginning to the end of the period.

The very precipitous character of the cliffs prevented me from reaching the upper part of the wall at this point, but I succeeded in making my way to the summit of the mountain at two other points, and found that everywhere the section was practically the same.

On the opposite side of the valley the same conditions were observed: the fossil trees occur at the highest point reached, 3,000 feet above the river. The ranges that form the rim of this valley on the north and east reach an elevation of 11,500 feet, and as the conglomerates may be seen reaching and forming the loftiest summits without perceptible break or change of character, it is probable that they will be found to enclose the remains of forests throughout.

On some of the higher summits to the east of Yellowstone Lake, similar stratified conglomerates contain silicified wood in a very fragmentary state. These conglomerates are composed mainly of basaltic and trachytic materials, but contain large quantities of fragments of sandstones and quartzites, which leads to the conclusion that portions of the earlier Tertiary strata have been broken up and ejected with the igneous products. It is quite probable that these strata were among the later products of the Volcanic Tertiary age proper. They are generally found abutting against masses of unstratified igneous materials that probably mark the sites of islands which were doubtless volcanic centers. I find that as we recede from these centers of eruption the strata diminish very perceptibly in thickness and coarseness of materials, and have at the same time a very perceptible dip toward the surrounding valleys. One is at times led to suspect that portions, at least, of these beds are of subaërial formation, as is the case with extensive strata about the cones of modern volcanoes, but there are a multitude of facts that go to prove that the greater part of the formations of this age were rearranged or sedimented in water.

As to the character of the seas or lakes in which the Volcanic Tertiary beds were laid down, it is clear that their waters were fresh, but as to their extent or distribution little is known. The formations cover or have covered an area of not less than 10,000 square miles, but they lie at a much greater elevation above the sea than the formations of synchronous lakes of neighboring provinces, and, so far as is known, have no actual connection with them.

It has been suggested by some one that these coarse volcanic strata may have been formed in very restricted bodies of water held high amongst the mountain ranges; but lakes cannot exist without barriers, and as has already been shown, the conglomerates, although naturally disintegrating more rapidly than any of the older rocks, now form the summits of many of the highest peaks that face the eastern plains, and the basins in which they were formed must have had free communication with the lowlands to the west, from the beginning to the end of the period.

For my present purpose it is sufficient to know that the bodies of water of this period were of sufficient extent not to be greatly affected in level by the filling-in of volcanic products or by the oscillations of the district under discussion, since we can have no correct measure of those oscillations of the surface which define the thickness and decide the character of strata without the barometer-like records of a sea-level.

The change of level produced by the great oscillation that preceded the Volcanic Tertiary period, and brought the lofty ranges of this region into existence, cannot fall far short of 20,000 feet. In order to reach these figures, we have but to add to the full thickness of the palæozoic and mesozoic strata the present elevation of the granitic ranges above the lowest observed stratum of the Tertiary rocks. At the beginning of the deposition of the Volcanic Tertiary rocks, however, the upward movement had ceased. The land had undergone enormous erosion, and subsidence had commenced. The great ranges that had lifted their crests to such lofty heights were again sinking beneath the sea. This subsidence did not cease until all, or nearly all, of the mountain peaks were submerged. It is in the strata deposited during this great subsidence that we must look for evidences of conditions and events that made the entombment and preservation of a vertical mile of forests possible.

The Yellowstone Valley, from the head of East Fork to the Lower Cañon, is carved out of strata which were formed along the west and south bases of the main eastern range of mountains. In many places the river has penetrated the full thickness of Tertiary strata, and has cut down into bodies of metamorphic rocks that at the beginning of the age were promontories or islands. It is plain, therefore, that those parts of the tree-bearing strata examined, were deposited along a shore-line, or, at least, near the borders of the Tertiary lake. Over large districts there must have been, during the period of general subsidence, a frequent alternation of land and sea. Land would have to exist while the forests grew and matured; water would have to cover the same area to deposit the succeeding stratum; and again this stratum would have to rise above the water before a second forest could grow. There are two ways in which this result could be brought about. In a district subject to such intense volcanic action as this must have been, a succession of minor oscillations might have been associated with the general subsidence, so that large areas of the lake border districts would be alternately above and beneath the sea, or, as was doubtless often the case, the shallow portions of the sea became filled up with the rapidly accumulating ejecta, and sub-aërial deposits of sufficient depth were laid down to allow the growth of forests, which, in time, were depressed by the general subsidence, to be buried by a succeeding stratum of the volcanic débris. But this latter method was not the ordinary one, as is attested by the fact that many of the forests have grown in beds of fine-grained material that must have been formed beneath the surface of the water.

I shall, however, not attempt to pursue this matter farther until all the data and materials collected have been examined. A thorough study of the various volcanic rocks will probably throw much light upon this very interesting group of strata.

thern Pacific Hotel,
J. N. HARDER, MANAGER.

Bozeman, Mont., August 21st 1883

My Dear Holmes.

Your kind letter came uly to hand. I am sure. I wish ou were along - You would make the work fly - and besides you would d much to my pleasure. It would truly seem like old times. There was a bird flew up into this far western country with a paper in its mouth. which when examined, contained a statement that you were about to become a married man. What does this all mean? I suppose Miss Osgood is the lucky lady. I am sure I wish you much joy and congratulate you. Miss O. always impressed me most favorably - I can see no objection to making yourself happy; do you? I think I am getting better on the trip - I am making such observations as I can along the route and the study of the geology is very interesting ou know I have studied much of it in past years. and thus I can work in my notes of this year with much of th past work. I cannot get about mu but I am thankful to be able to ge up here and see these old mountain peaks again. I can say with Wm Tell! "Ye crags and peaks. I'm with you once again". The old spirit comes over me to work, but I am chained down by disease. I thin however that another year I will be strong again. It is so cold today here. that we need a fire. The chang in the climate are not favorable to m I shall return early in Sept. for I fea the sudden changes & the storms. Besid I have done about all I am able t the voyage to Helena. and hope to make a stu of the great Tunnel. 4.000 feet long On our return we will study the Bozema Tunnel. which is now being made in th Coal beds or Coal strata. below Bozeman. My best wishes attend you. I wish I could see you. I saw yo men at St Paul & Minneapolis

Ever yours sincerel

F.V. Hayden

Schuylkill Haven Pa
May 1st 1883

My Dear Holmes

I have just got back from Philadelphia where I saw Dr. Hayden. I had hoped to learn something definite as to this summers work, but all I could get out of him was that Powell had told him to assure me that my appointment on July 1st was a certainty. As to plans of work he was very vague as usual probably because he do not know anything definitely as to Powells plans. Of course I see that I will have to take the lead but I must know what field Powell wants Hayden to take up. and to learn that I suppose I shall

say something nice to you but those sorts of things are not exactly in my line, so take the intention or rather "the will for the deed."

I am anxious to know if you think I ought to come to Washington & when. I will be guided by what you say.

Hoping I am not trespassing too much on your time (as I did not mean to write so long a letter) I am as ever

Yours
A. C. Peale

have to visit Washington either this month or next. What do you think? In the present condition of Powell's health I suppose it would be useless to go on now. I wish you would advise me about this.

Another point I wished information on from Hayden but could not get it. I feel that the appointment is a certainty but between now and the 1st of July I have to live and I want to get out of this business all that I possibly can. June here is the heaviest month. I wanted to know if I was to take the field on the 1st of July sharp. If so I must begin to close up a week before. I think it will take a week to finally close up my business relations here. If possible I would like to begin to close up so as leave on the 8th. I don't wish to do it until I have the appointment in hand. If I did so before and there should be a slip I would be out for my partner here would undoubtedly hold me out & I would be out in the cold. However this is something I would have to arrange with Powell should I come to Washington.

Whatever field Powell wants Hayden to take up my idea is that the first year I ought to devote to getting a general idea of it so as to be able to take it up systematically. How is Powell now? I heard that he has just been to Philadelphia to consult Dr Mitchell & others.

My wife received the photograph and her remark was that "it is lovely. She says I shall

STAR, WASHINGTON, D. C., THURSDAY, JANUARY 23, 1930.

STEPHEN MATHER DIES SUDDENLY

Had Served as Director of National Park Service Under Three Presidents.

Stephen Tyng Mather, director of the National Park Service under three Presidents, organizer of the service, and the man credited with forcing public recognition of the national parks and raising them from the status of orphans of the Nation to the stature of national playgrounds, is dead at Brookline, Mass., where he had gone several weeks ago for treatment at the Corey Hill Hospital.

Mr. Mather's death last night was sudden and unexpected, as several of his friends in Washington had received letters from him as late as two days ago. A second stroke of paralysis, which came 15 months after he suffered a similar stroke in Chicago on election day, 1928, caused his death.

Funeral services for Mr. Mather, who had received national and international recognition for his outstanding achievements in the field of national park development, probably will be held Saturday afternoon at St. Mark's Church, New Canaan, Conn. He will be interred at Darien, Conn., where he maintained a home.

Health Forced Resignation.

Mr. Mather's death came 13 years and 1 day after he took over the direction of the national parks, and only a little more than a year after his resignation from the post of director of the National Park Service. After serving as an assistant to the Secretary of the Interior in charge of national parks for more than two years, he was appointed director of the service in May, 1917, after having been in charge of the parks since January 21, 1915. Failing health forced his resignation as director of the service on January 8, 1929. He was succeeded as director by Horace M. Albright, who had been acting director of the park service during Mr. Mather's illness.

At the time of his death his legion of friends throughout the United States, numbering many men and women high in the official and social life of the nation, were marshaling for a permanent testimonial of his work. This testimonial, known as the Stephen T. Mather Appreciation, now will probably take the form of a memorial, according to friends here.

Park Organizer Dies

STEPHEN TYNG MATHER

Headquarters of the organization is in Washington, and a meeting will be held in March to decide on the form of the testimonial, on the return from a trip to South America of John Hays Hammond, chairman of the national committee. Others on the committee are: Representative Louis W. Cramton of Michigan, Dr. Gilbert H. Grosvenor, president of the National Geographic Society; Dr. Vernon Kellogg, secretary of the National Research Council; Theodore W. Noyes, editor of The Star, and Mrs. Henry A. Strong, chairman of the board of the Hattie M. Strong Foundation. George W. White, president of the National Metropolitan Bank of Washington, is treasurer of the fund of $150,000, to be raised to create the testimonial. One of the suggestions made to perpetuate the work of Mr. Mather is purchase of a grove of sequoia trees and their inclusion in a park to be named after him.

Worked for Civic Betterment.

Possessor of striking personality and having the faculty of quickly making friends and holding them in bonds of mutual work and companionship, Mr. Mather leaves a lasting imprint on national life. Unobtrusive, vigorous, a man of the outdoors, ever pressing for expansion of the national parks along educational and recreative lines, he had seen the development of the National Park Service from little more than a vision and a few desks in a small office in the Interior Department Building to the vast organization it is today, stretching its network literally from Maine to Alaska. Always a leader in the cultural life of the community, Mr. Mather was instrumental in the formation of the National Capital Park and Planning Commission, was one of its members for several years and always stood for civic betterment along approved lines. He always had taken a deep interest in the development of the National Capital and his advice had been sought on many occasions by leaders and developers of thought along those lines.

He virtually created the post of director of the National Park Service. When he took over the task under Secretary of the Interior Franklin K. Lane, the parks were not in a prosperous condition. Congress had bought or set aside land for them, but their development stopped at that point. Nothing had been done to make them popular

A very good friend of mine
W.H.A.

or accessible and they were operated as separate units.

Rehabilitation and development of the national parks became a pet project of the director. Possessed of a comfortable private fortune and a host of friends, this man who had worked his way through college and had later gone into newspaper work, brought his unflagging interest to the cause of education of the people to the parks and their development.

Criticism Won Position.

The manner in which he became identified with the public parks is an interesting story. One Summer he had visited several national parks and expressed his displeasure at the methods of their exploitation. On his return he wrote a letter to the authorities in Washington registering his protest in characteristically vigorous terms. A short time later he received a letter from Secretary Lane, who had been a college chum, reading as follows:

"Dear Steve: If you don't like the way the national parks are being run, why don't you come down here to Washington and run them yourself? I mean this sincerely. Come on."

The two met a few days later in Chicago. "You're just the man I'm looking for," Secretary Lane said. "You are going to Washington as my assistant."

It was all news to Mr. Mather, but when Secretary Lane told him he had already announced the appointment to the newspapers, Mr. Mather agreed to go.

He arrived in Washington with the rank of an assistant to the Secretary and the salary of a stenographer, and went to work. His authority was ample, even though the job itself was little more than a mirage. From that humble beginning has come the great network of national parks, which attract hundreds of thousands of persons annually and today wield vast authority along educational lines in the national life. Hotels, roadways and other man-made comforts make the parks accessible and comfortable today, but generally their natural condition remains as it has been for centuries. They are today expositions of the wild life of the Nation. Mr. Mather took a leading part in the steps which led to foundation of the Shenandoah National Park and the Great Smokies National Park, which ultimately will become the great mountain national park of the Eastern seaboard.

Worked Way Through School.

Born in San Francisco July 4, 1867, Mr. Mather worked his way through the University of California by selling books, later taking degrees at his alma mater and George Washington University in Washington. As a young man he went to New York and obtained a reportorial job on the old New York Sun, where his industry and zeal was quickly revealed. This newspaper background taught him the value of publicity, which he later turned to advantage in national park development.

Concluding that newspaper work held little for him, he joined the Pacific Coast Borax Co. in New York and later in Chicago, where he opened its Western offices. One of his jobs was making friends for the borax company, which then was under fire and needed help. Borax in those days was hauled across the desert by mule teams.

In his campaign of publicity he showed mule teams in many important cities throughout the United States. But, with the aid of chemists, he evolved a new method of refining raw borax, and after an unsuccessful attempt to have his company adopt the method, formed a partnership with a young engineer who knew of other borax deposits. They formed a company to challenge the borax trust, with Mr. Mather at the head, and were successful. That company is the Sterling Borax Co., whose president Mr. Mather was at the time of his death.

Used Own Money for Parks.

Shortly after his successful fight with the borax trust, when his business was on a firm foundation, he came to Washington to head the park service. Not satisfied with the funds Congress granted the park service, Mr. Mather dug deeply into his private fortune at various times to attain objects he deemed desirable in national park development.

His pleasing personality went a long way toward making friends for the parks, in and out of Congress. One of the projects into which his own money went was purchase of the Tioga road, across Yosemite National Park, in California. Others included purchase of groves of sequoia trees and provisions for quarters for the park rangers.

One of his forbears was Cotton Mather, the famous New England minister, while another was Elder Brewster. He had purchased and restored the old Mather homestead at Darien, Conn.

His home was in Chicago, where he maintained a residence at 5638 Dorchester avenue, and had extensive real estate interests, although he had lived in Washington since 1915. He was known in Chicago as the "perfect landlord."

Mrs. Mather and a daughter survive him. He was a member in Washington of the Cosmos Club and the National Press Club, in addition to clubs in other cities, and also was a member of the District Society, Sons of the American Revolution.

Mr. Mather had received from the King of Sweden a decoration in recognition of his outstanding work in national park development. Gold medals from the National Institute of Social Science of New York and the Cornelius Amory Pugsley Foundation also had been presented to him for similar achievements.

See page 70 - (far back)

September 4, 1928.

Dear Mr. Mather:

I must apologize for long delay in writing you regarding the purchase of the Moran Grand Canyon by Mr. Pratt for the Gallery. Copies of my letter to Miss Moran and to Mr. Pratt are enclosed herewith and make clear my high appreciation of the good fortune that has come to me and to the Gallery.

But the story of the acquirement of this work is not complete until you and Mr. Cammerer have a place in it. The initial step in the episode was your purchase of the Moran field sketches in New York and their assignment temporarily to my care. This resulted in the visit of Mr. Pratt and Mr. Cammerer to the Gallery and to my office which gave me the opportunity of indicating to Mr. Pratt my very great appreciation of the work and my fear that it might some day find a home elsewhere. Mr. Pratt visited the Gallery and was duly impressed with the importance of the picture and this resulted in the offer of ten thousand dollars, which was gladly accepted by Miss Moran. The result is a most happy one and I am sure that you share in my elation.

Sincerely yours,

W. H. Holmes

Director.

Mr. Stephen T. Mather,
Director, National Park Service,
Washington, D. C.

Purchased from Messrs [illegible]
by Mr. Riddle July 1928.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

Yellowstone Park, Wyo.,
April 10, 1930.

Dr. W. H. Holmes,
Cosmos Club,
Washington, D. C.

My dear Doctor Holmes:

After leaving you I enjoyed a splendid visit with W. H. Jackson. From him I obtained a fine series of old prints showing individuals who participated in the early Geological Survey activities in Yellowstone. I discovered, however, that none of the six pictures included in your diary were represented in the Geological Survey collection or in the personal collection possessed by Mr. Jackson. Should it not be too much trouble I should be glad to have one of your photographers copy your pictures and supply us with the negatives. We shall of course gladly meet the expenses involved.

My talk with you was a most enjoyable experience and your kindness in supplying a carbon copy of your Yellowstone diary is greatly appreciated by me and by the Park Service. The copy has now taken a place in the Yellowstone files and will be of particular service in the preparation of our history exhibits.

I wish that I might have the opportunity to take you about the present day Yellowstone and learn from you of your pioneer experiences here. Should you come to Yellowstone this summer please let me know of your plan.

Gratefully yours,

C P Russell

C. P. Russell,
Field Naturalist.

NOTE ADDED IN THE NATIONAL GALLERY FEBRUARY 7, 1929.

The many marvels of the park are now - fifty years after - fully described and illustrated in a multitute of publications. In 1871 the first scientific exploration was made by Hayden and a small party though Langford's party had visited the geysers the year before. In 1920 good roads had been built everywhere and there were 13,000 automobiles registered in the park.

In 1925 I was invited to visit the Park by the Superintendent, Mr. Albright, who planned to furnish me transportation by rail to the gate of the Park and drive me in a Park automobile to every point of interest in the Park, but I had to decline, my duties as Director of the National Gallery were so exacting that the time could not be spared.

These notes were added by me at my desk in the National Gallery, National Museum building, on February 7, 1929, and a note may here be made of the fact that recently the great painting by Thomas Moran of the Canyon and the Fallsof the Yellowstone was purchased from Miss Ruth Moran, daughter of the painter, by Mr. George D. Pratt of New York for ten thousand dollars, and presented to the Gallery.

W. H. Holmes

(*From the American Naturalist, April,* 1879.)

NOTES ON AN EXTENSIVE DEPOSIT OF OBSIDIAN IN THE YELLOWSTONE NATIONAL PARK.

BY WM. H. HOLMES.

CONSIDERABLE deposits of obsidian and obsidian porphyries had been observed in the national park previous to our visit in the summer of 1878, but no satisfactory exposures of the glassy varieties had been found. In October I had occasion to make examinations of a locality particularly rich in them, situated in the north-western part of the park, near the head of Obsidian or Alum creek, a tributary of the middle fork of Gardiner's river. The crumbling trachytes of this part of the park give, in general, a rounded and monotonous character to the topography. The slopes of the valleys are gentle excepting at points where the glassy rocks predominate.

In ascending Obsidian creek, by way of the newly-cut wagon road which connects Mammoth Hot Springs with the Geyser Basins, we pass first through broad meadows and parked forests. Farther on the valley narrows up and the timber becomes extremely dense. At a point about twelve miles above the junction of the creek with the main stream, there is a narrow gateway known as Obsidian cañon, through which the road and creek pass. From the east side of the valley a low promontory extends forward to the creek and breaks off in an abrupt nearly vertical wall, in which the obsidian rocks are exposed. The road approaches the cañon along the west side of the valley, and crosses to the east side at the lower end of the cañon; in order to avoid the swampy ground that borders the stream it has been carried across the steep débris slopes of the obsidian cliffs. For half a mile it is paved with glassy fragments and lined by huge angular masses of black and banded obsidian rock. From the upper border of the débris slope the vertical cliffs rise to the height of nearly two hundred feet. The lower half is composed of a heavy bed of black obsidian which exhibits some very fine pentagonal columns, somewhat irregularly arranged and frequently distorted, but with perfectly cut faces that glisten in the sunlight. The upper portion of the wall is composed of a much more obscurely columnar mass of impure spherulitic obsidian, the rude faces of the columns being often as much as ten or twelve feet across. To the right and left the columnar character becomes less marked, both in the upper and lower part of the cliff, and farther out seems to be entirely lost, the glassy rocks grading into the gray sanidine trachytes and obsidian porphyries of the surrounding hills.

Extending upward from the edge of the promontory in a moderately gentle slope are four or five hundred feet of obsidian strata that exhibit some most interesting characters. There is no heavy mass of pure glassy rock, but a succession of irregular layers of a dozen or more varieties of spherulitic obsidian, obsidian porphyries and breccias. The colors of these rocks are exceedingly varied, the prevailing blacks giving way to reds, browns, greens and the richest possible marblings and mottlings.

One of the most striking characteristics of these rocks are the spherulitic concretions which occur to a greater or less extent in all the varieties. These bodies seem to prevail in the ashy-like bands or layers which, in the more compact mass toward the base, are frequently contorted, giving the rock the appearance of a banded and contorted gneiss. The ashy-appearing layers are probably composed of the same material as the concretions, since when we split the rock *with* the bands, the surfaces of the gray bands next the glassy layers are simply a connected or coalescent series of nodes or hemispheres which have the usual appearance of the more isolated concretions. Where the concretions are scattered throughout the glassy mass, they are globular or composed of a cluster of globes. They have, in most cases, a distinctly radiated structure, with not infrequently concentric layers near the surface. The interior is gray or pinkish-gray, and the surfaces, pinkish or flesh colored.

In the coarsely columnar part of the wall the spherulites are often a foot or more in diameter and appear much flattened and distorted. It is probable that these irregular forms are produced by the coalescence of a large number of smaller ones, as there are apparently many centers of radiation. Large beds of the rock seem to be made up almost wholly of the concretions, and where decomposed, a mass of coarsely cellular or honey-combed obsidian remains. The brecciated beds consist of an ashy matrix in which are imbedded angular fragments of every variety of the brilliantly-colored spherulitic and ordinary obsidians.

The collection of hand specimens made at this place is very complete, numbering upwards of three hundred. Their examina-

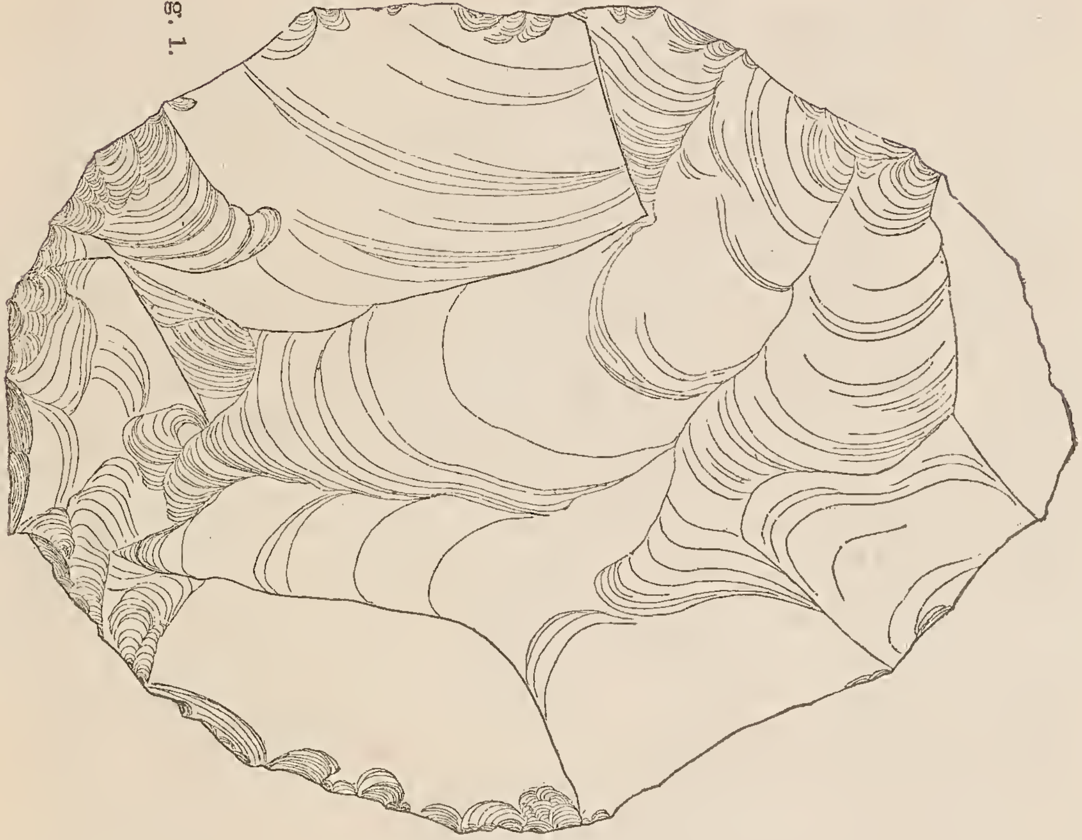


Fig. 1.

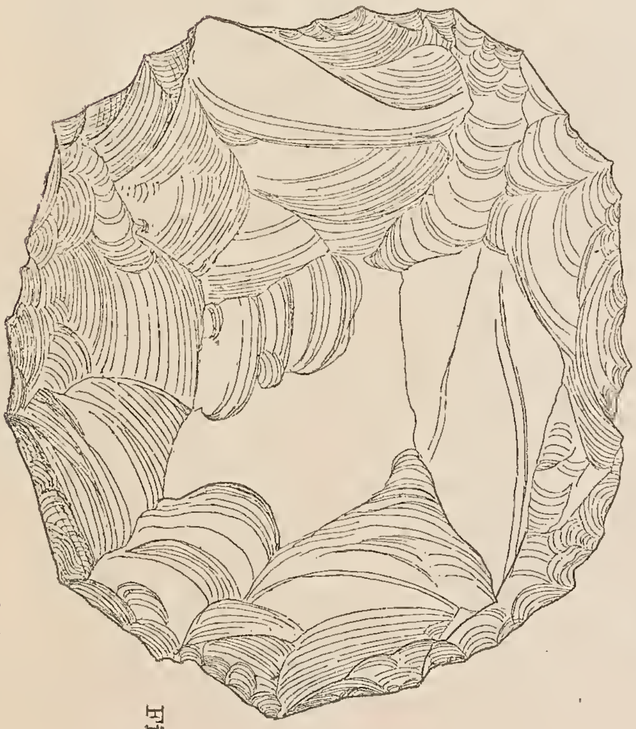


Fig. 3.

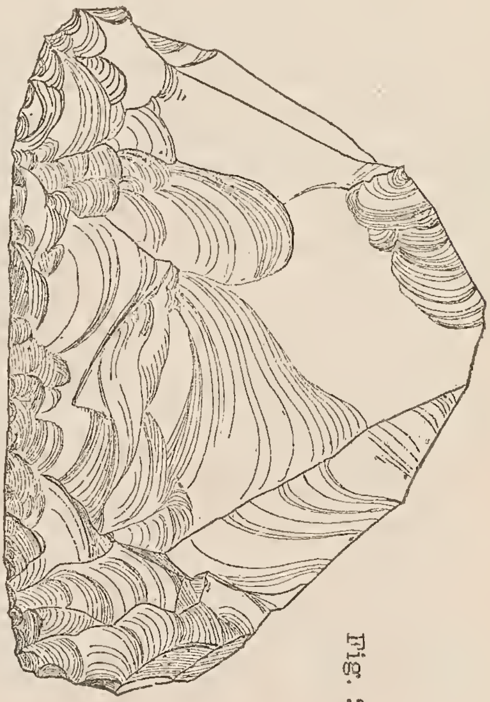
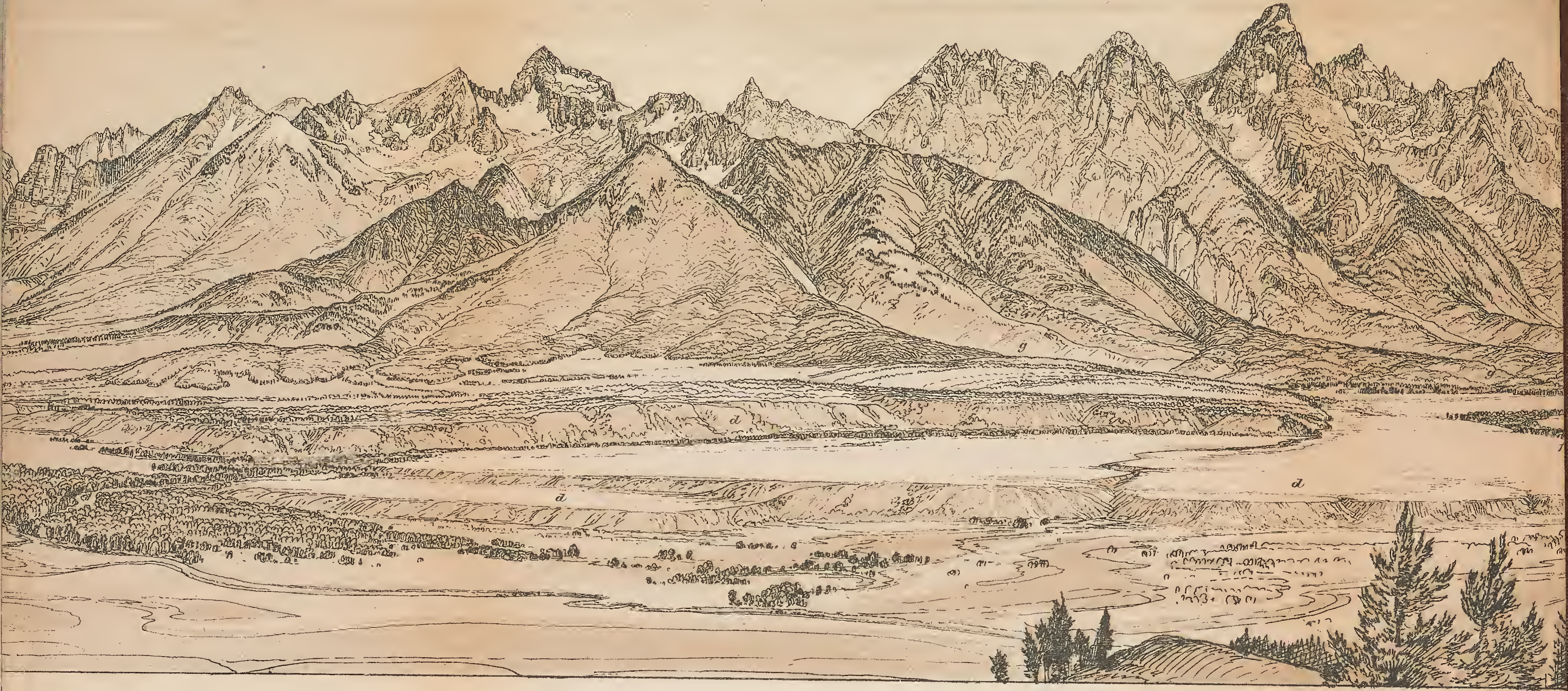


Fig. 2.

tion by specialists in petrography will doubtless develop many new and interesting features, as no equally rich deposit of similar rocks has heretofore been brought to their notice in this country.

Indian Implements.—It occurred to me, while making examinations at this point, that the various Indian tribes of the neighboring valleys had probably visited this locality for the purpose of procuring material for arrow-points and other implements. A finer mine could hardly be imagined, for inexhaustible supplies of the choicest obsidian, in flakes and fragments of most convenient shapes, cover the surface of the country for miles around.

Having climbed the promontory, I observed that an old but quite distinct trail passed along the brink of the ledge and descended the broken cliffs to the valley above and below. In the vicinity of the trail the glistening flakes proved to be more plentiful than elsewhere, and were also apparently gathered into heaps. After a short search a leaf-shaped implement of very fine workmanship was found ; it is made of the black opaque obsidian, and is four inches in length, three inches in width and one-half an inch in thickness ; an outline of this implement is given in Fig. 1. Having continued the search as long as the time at my command would permit, I was amply rewarded in the possession of ten more or less perfect implements. Three are leaf-shaped and nearly the same in size as the first specimen found, but imperfect from having been broken. One is somewhat pyramidal in shape, as shown in Fig. 2 ; the bottom is flat, the flaked surfaces extending from the base to the apex ; it is two and a half inches in width and one and three-quarters in height, and is the only specimen in the collection that appears to have been in the least used ; the sharp edge at the base is considerably worn ; Fig. 3 is a top view of the same. Another specimen is triangular in shape with sides about three inches long ; another is rectangular and about three inches wide by four in length, and still another is a rude oval ; nearly all of these implements are imperfect, as it broken or unfinished. If we are to suppose that the great quantities of minute flakes are the fragments left from the manufacture of implements we must conclude that extensive supplies have been obtained here, but by what tribes or at what period it will be quite impossible to determine.

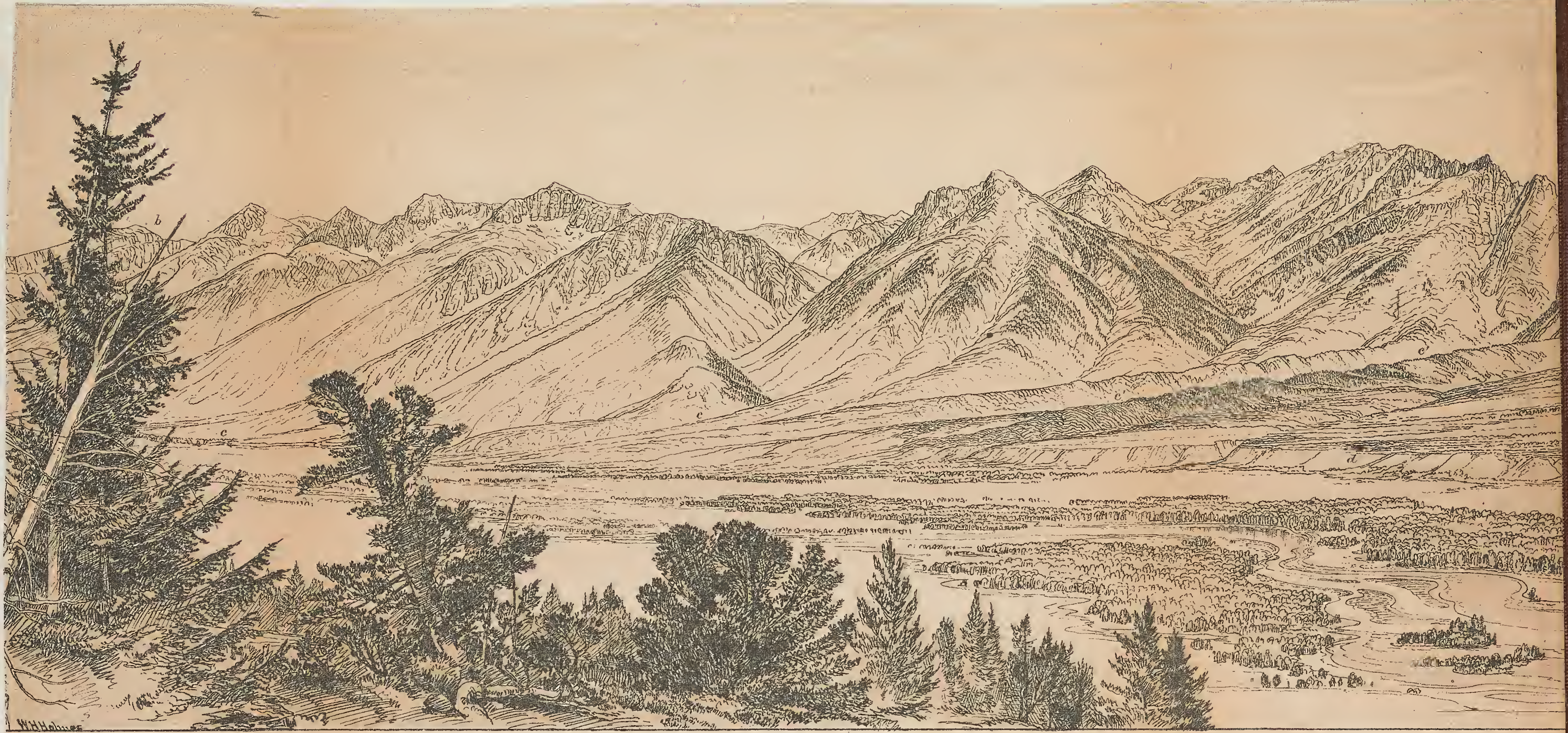


The body of the Range is Granitic.

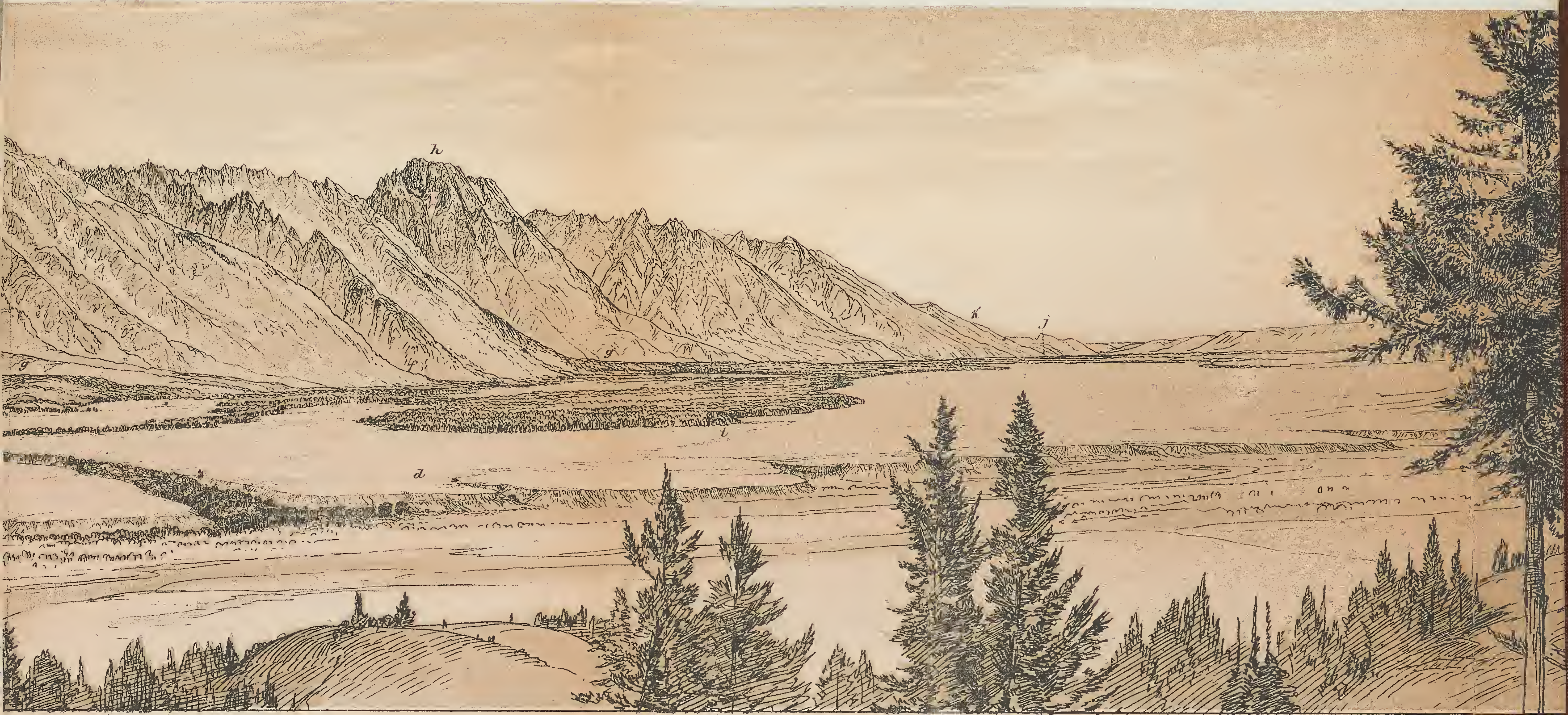
e. Grand Teton. Elevation 13,691 feet

THE TETON RANGE FROM UPPER GROSVENTRE BUTTE

LOOKING WEST, WITH THE VALLEY OF SNAKE RIVER IN THE FOREGROUND.


b
c
c
c
c
d
W.H.Holmes

ass b. Silurian Strata c Fighting Bear Creek c' Valley of Phelp's Creek and Glacial Moraines d. River Terrac



f. Cañon Creek *g.* Moraines *h.* Mt Moran *i.* Jenny's Lake *j.* Jackson's Lake *k.* Siluri

ADDRESS ONLY
DIRECTOR, NATIONAL PARK SERVICE
WASHINGTON, D. C.

DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
WASHINGTON

HAYDEN VALLEY

January 6, 1922.

Dear Dr. Holmes:

Mr. Yard has referred to us your note, addressed to him, of December 20, and we are writing to advise you that the name Hayden Valley appears on the topographic map of Yellowstone Park issued and for sale by the Geological Survey. On the small automobile guide map of the park, which this Service issues, the name has heretofore been eliminated because of the smallness of the map. However, your suggestion that the name appear is excellent and on the new issue of our small map we will try to show it.

Cordially yours,

Arno B. Cammerer

Arno B. Cammerer
Assistant Director.

I named this valley in 1878, realizing that the name of our chief - applied recently to the Grand Teton mountain, cannot hold. (Hayden, F.V.) was our chief.

Dr. W. H. Holmes, Director,
National Gallery of Art,
Smithsonian Institution,
Washington, D. C.

c
c
e
f
g
a
a
a
d
b
b

a.a.a. Soda Butte Creek. *b.b.* Valley of East For *c.c.* Stratified volcanic Conglomerates *d.d.* Beds of Basalt *e.* Baronettes Peak *f.* Norris Peak *g.* Index and Pilot Peaks

[illegible] panoramas 1878

VOLCANIC TERTIARY MOUNTAINS
NORTH OF THE EAST FORK OF YELLOWSTONE RIVER.

A ROMANCE OF THE YELLOWSTONE

GEOLOGY OF THE GRAND CANYON.

Notes introduced here in 1929, fifty years after the publication of my interpretation of the geology of the Yellowstone Canyon as reported in the Hayden Annual Report for 1878, by Professors Field and Jones. Their notices appear in the American Journal of Science, Volume XVII, March, 1929, and elsewhere.

W. H. Holmes

June 3, 1929

My dear Professor Field:

Thank you for the separate of your Journal of Science article on the Yellowstone Canyon Geology. It saves me from utter extinction geologically, and at the same time puts you and Professor Jones on the map to stay.

It pleases me to note that the little speck of granite showing at the south end of the Gallatin Range on my little map, is really Mount Holmes as named by Hayden and Gannett.

Very truly yours,

W. H. Holmes

Director.

Prof. R. M. Field,
Princeton University,
Princeton, N. J.

(168)

PRINCETON UNIVERSITY
PRINCETON NEW JERSEY

Department of Geology

February 25th, 1929

Dear Dr. Holmes:-

I am lecturing on the Geology of the Yellowstone National Park before the Geological Society of Washington on the evening of February the 27th. I am particularly anxious to see you when I am in Washington; and if you could spare a few minutes of your time to come to the lecture both Dr. Jones and I would appreciate it very much indeed. I am hoping that we may be able to dine together before the lecture, or possibly have a bite together afterward.

I am asking Dr. Goldman, of the Survey, to see you and determine if this can be arranged. I sincerely hope, however, that you will not allow my wishes to interfere in any way with your plans or tire you out in any way.

I am looking forward with great pleasure to seeing you again.

Very sincerely and cordially yours,

R. M. Field
H.

To:

Dr. William H. Holmes
National Museum
Washington, D. C.

I was in the Yellowstone Park in 1872 as artist to the Hayden Survey of the Territories, and in 1878 as geologist on that Survey. My report on the geology of the Park, with special record of the fossil forests, the glacial phenomena and the obsidian workers of the native tribes, was printed in the 1878 Report of the Survey.

On September 23, 1923, John Carter, son of Senator Carter, called at the Gallery and told me he had just returned from the Yellowstone and that he had seen and climbed my mountain.

On August 6, 1928, there called at my office in the Gallery Professor Owen T. Jones, Head of the Department of Geology, University of Manchester, England, and Professor Richard M. Field, Chief of the Department of Geology, Princeton University. They came to report that, after a thorough study of the geology of the Grand Canyon region, my analysis of the conditions & history structure was the only one so far made that could be regarded as satisfactory. They wished to compliment me and were very anxious to get signed copies of the Report. Unfortunately copies were not available.

Citations from their work [illegible]

THE RESURRECTION OF THE GRAND CANYON OF
THE YELLOWSTONE.

O. T. JONES AND R. M. FIELD.

American Journal of Science March 1929

[illegible]

[illegible] conformed by [illegible]

[illegible]

A [illegible] of the [illegible]

THE RESURRECTION OF THE GRAND CANYON OF THE YELLOWSTONE.

O. T. JONES AND R. M. FIELD.

INTRODUCTION.

During the visit of the Princeton Summer School of Geology and Natural Resources to the Yellowstone Park in 1926, one of us (R.M.F.) observed cross-bedded sediments in the wall of the Yellowstone Canyon near Red Rock. This observation was made from a point on the opposite side of the gorge a short distance below Canyon Camp. Time did not permit a visit to the Red Rock, but the distant view of the sediments suggested that they lay behind Red Rock in a curved channel which was once part of an old meander. This fact suggested that there had been at least two cycles in the erosion of the canyon with a period of infilling between the first and second cycle. During the visit of the Summer School on July 5, 1928, the authors together with Messrs. W. A. Johnston and Parks studied the stratified beds of the Red Rock locality, while other members of the party under the leadership of Dr. E. L. Perry discovered sediments on the Lower Falls trail within 40 to 50 feet above the bottom of the canyon. Further investigation by Jones, Field, and Johnston showed that there were other remnants of filled channels exposed in the canyon walls between the upper and lower falls. The evidence as a whole, taken in conjunction with the distribution of the glacial deposits, pointed very clearly to the fact that the present canyon of the Yellowstone follows pretty closely along the course of a previous canyon which must have been cut, dammed, and filled to the brim with sediments in preglacial times. At this stage in the investigation the party left the Park and the discussion was continued on the train, while travelling south. Careful examination of the geological map in the Yellowstone Park Folio led to the suggestion that the preglacial gorge of the Yellowstone River might have been dammed by lava flows. Hague has described certain basalt flows in the lower part of the "Grand" Canyon as interbedded with the Canyon conglomerates and underlying the rhyolites. It seemed probable, however, that the basalt flows mapped by Hague in the Yellowstone and Lamar River valleys did not underlie the rhyolite but were remnants of flows lying on the valley floors and perched on the valley sides. At Thermopolis

(171)

2

the authors of this paper decided to return to the Park to test their conclusions. Thanks to the transportation facilities placed at our disposal by Mr. William Nichols, and the kindness of Miss Adelaide Nichols in driving us against the traffic from Mammoth Hot Springs to Roosevelt Lodge, we were able to examine certain of the lavas and to prove conclusively that they had flowed up the preglacial valley of the Yellowstone, and had probably served as the dam which impounded the water in the canyon. This evidence became increasingly clear as we approached the junction of the Yellowstone and the Lamar, and is beautifully demonstrated between Junction Valley and Tower Creek. Upon our return to the east we reexamined the bibliography on the geology of the Yellowstone Park. Since the publication of the Yellowstone Folio in 1905, we could not find any record that the facts mentioned above had been noticed by any previous observers. Upon referring to Hayden's Survey of the park in the twelfth annual report for the year 1878, we were surprised and delighted to find that Holmes[1] in his excellent geological description of the northern portion of the park gives abundant evidence both written and pictorial that he had observed several of the important features given in detail later in our paper, and that he was on the verge of reaching the same conclusion as we do. We feel that we could not do better than to quote the following paragraphs from his paper:

"Something of the past history of this Valley can be learned from the facts here observed (at Jasper Creek, now shown on the map as Deep Creek). A stream—whether the Yellowstone or not, no one can say with certainty—had cut down through the Tertiary strata to a depth of 600 feet below the top of the present valley, and about 400 feet above the bed of the present river. The lava has flowed into it, filling the valley to the depth of 200 feet or more. Whether this occurred before or after the flow of the rhyolite I am unable to say from any facts observed, although on general principles we would probably be safe in concluding that it is more recent. The debris at the ends and on the top of the mass of basalt make it difficult to say whether it passes beneath the rhyolite of the main wall of the canyon or is simply set against it. The fact that it does not continue across the crater to the right, as seen in the drawing (plate 21, p. 38), proves nothing, as the rhyolite, which extends down the opposite spur to a point considerably below the base of the basalt, may have been

---

[1] U. S. Geol. and Geogr. Surv. of the Territories of Wyoming and Idaho, 1878, Part II, pp. 39-40.

deposited either before or after it. I had not time to go on with this interesting investigation or I should, without doubt, have been able to solve the whole problem of the relative ages of all the canyon rocks."

Again on page 42 he writes:

"This valley (Junction Valley) is situated in one of the most interesting as well as one of the most beautiful regions in the park. The geologist might find a year's profitable work within a radius of ten miles about Baronett's Bridge, and the tourist could find almost unlimited sources of pleasure. Geographically there are illustrations of many most interesting problems of geological history and the very perplexing events of the volcanic Tertiary period may be studied to the best advantage.

"North of the valley lies the range of Granitic Mountains that must have looked down in succession upon the Eocene, Miocene, and Pliocene lakes and witnessed the extraordinary events of the volcanic period. Here, during the latter part of the volcanic epoch, while the subaerial deposits were in process of formation, the erosion seems to have been more than usually deep. The trachytes and rhyolites were poured out into the valleys cut in the Tertiary and Paleozoic rocks. Subsequent flows filled in the valleys eroded from the first flows, and so on through the basaltic and conglomerate producing period. On account, however, of the occurrence of so many products together, their relations are hard to make out. This may be remarked of the Tertiary strata, especially the several groups of which cannot easily be distinguished from the conglomerate formed in more recent times through alluvial and volcanic agencies, and possible identifications are very nearly impossible. Of course, prolonged study may make everything clear."

It seems remarkable to the authors of this paper that no attention has been paid to the penetrating observations of Holmes and his colleagues made over half a century ago. The report of 1878 is replete with careful observations and beautifully accurate drawings by this master artist of geological subjects and the scientific interpretation of scenery. We do not feel that it is necessary to quote the conclusions of all subsequent workers as the prevailing opinions regarding the geology and physiography of the Yellowstone Canyon appear to be expressed in the following paragraphs taken from J. P. Goode[2] and E. de Martonne[3]:

---

[2] Goode, J. P., The Piracy of the Yellowstone, Jour. Geol., 7, 261-271 (citation, p. 261), 1899.

ments. According to Holmes (page 37) the conglomerate lies about 100 feet above the top of the upper fall and therefore at an altitude of slightly over 7,800 feet. It is interesting to observe that this altitude is about 60 feet higher than the surface of the existing Yellowstone Lake.

In order to complete the story of sedimentation in this region, it is necessary to descend the canyon by Uncle Tom's trail to the foot of the lower falls. About 50 feet above the level of the river the trail has been cut partly in the rhyolitic rock and partly in coarse compacted sands which in places show conspicuous cross-bedding. These sediments rest on a very narrow shelf composed of rhyolitic rocks and were observed by Holmes.[5]

At about the same or slightly higher level on the opposite wall of the canyon there is a conspicuous bluish patch which is drenched by the spray from the falls. The appearance of the material as seen from this distance reminds one strongly of the blue laminated silts in the Red Rock section and it might without much hesitation be identified as argillaceous sediments. Fortunately, however, we found on consulting the earlier reports on the Yellowstone Park that this locality had been visited by A. C. Peale[6] who describes it as a bluish gray mud. He also observed in close association with it a fine-grained argillaceous sandstone, but he attributed these rocks to the sliding down of the "soft volcanic ashes" forming the walls of the canyon. This cannot be the origin of the cross-bedded sandstone on Uncle Tom's trail on the east side, and we believe our interpretation of the mud as a portion of a sedimentary filling of the canyon to be the correct one. Taken in conjunction with the section near Red Rock, the arenaceous and argillaceous deposits near the bottom of the canyon probably represent the earlier stages in the filling of the first lake which was formed in this part of the canyon, the final stage of which is the conglomerate group at the base of the Red Rock section. The significance of this deposit did not escape Holmes. He remarks:[7]

> "In regard to that on the east side of the canyon just below the lower falls that they have very much the appearance of the lake beds which occur on the upper surface of the plateau. If it could be ascertained that they really are lake beds, they would take a very important place in our discussion of the erosion of the canyon."

---

[5] Ann. Rept., U. S. Geol. and Geogr. Surv., 1878, Pt. II, p. 36, 1883.
[6] Ann. Rept., U. S. Geol. and Geogr. Surv., 1872 (1873), p. 233.
[7] Op. cit., Sup.

country of the world. Professor Holmes is proud of his record as a mountaineer, having been first to reach the summit in this and in every other ascent made during the Colorado work. Copied to Hess

In 1878 the Survey again visited the Yellowstone region and Professor Holmes' researches as geologist ~~work~~ extended over a large part of the Park, his morphologic studies of the Grand Canyon being of very especial interest. He observed It was determined that great flows of lava, probably in glacial times, ~~were~~ had formation filled the narrow gorge of the river, which normally flowed to the North, turning it temporarily out of its course. ~~to the South~~. The glacial ice sweeping down from the North had scattered granite masses, derived from the Northern highlands over the plateaus to the South, suggesting the conclusion [illegible] ~~completing the story~~. This interpretation was verified fifty years later (1928) by the researches of Professor R. M. Field, Chief of the Department of Geology, Princeton University, and Professor O. T. Jones, Head of the Department of Geology, University of Manchester, England, who spent the summer in the Grand Canyon region.

It happened in 1874 and 1875 that Professor Holmes' geological activities brought him into contact with the interesting archeological remains of Colorado. Studies were made of the Cliff dwellings and the associated art remains, and later corresponding researches were carried over many of the states and territories extending from the Atlantic to the Pacific, and from Canada to Mexico from New Jersey on the East to California on the West. His report to the Field Columbian Museum on his studies in connection with the A. V. Armour expedition to Yucatan in 1895 threw much new light upon the

Holmes [illegible] the [illegible] 187

if not from the Miocene. Considering the time that must have intervened between the excavation of the canyon and the rhyolitic eruptions, the period of those eruptions must be pushed far back into the Tertiary period and these lavas are therefore much older than had been previously supposed.

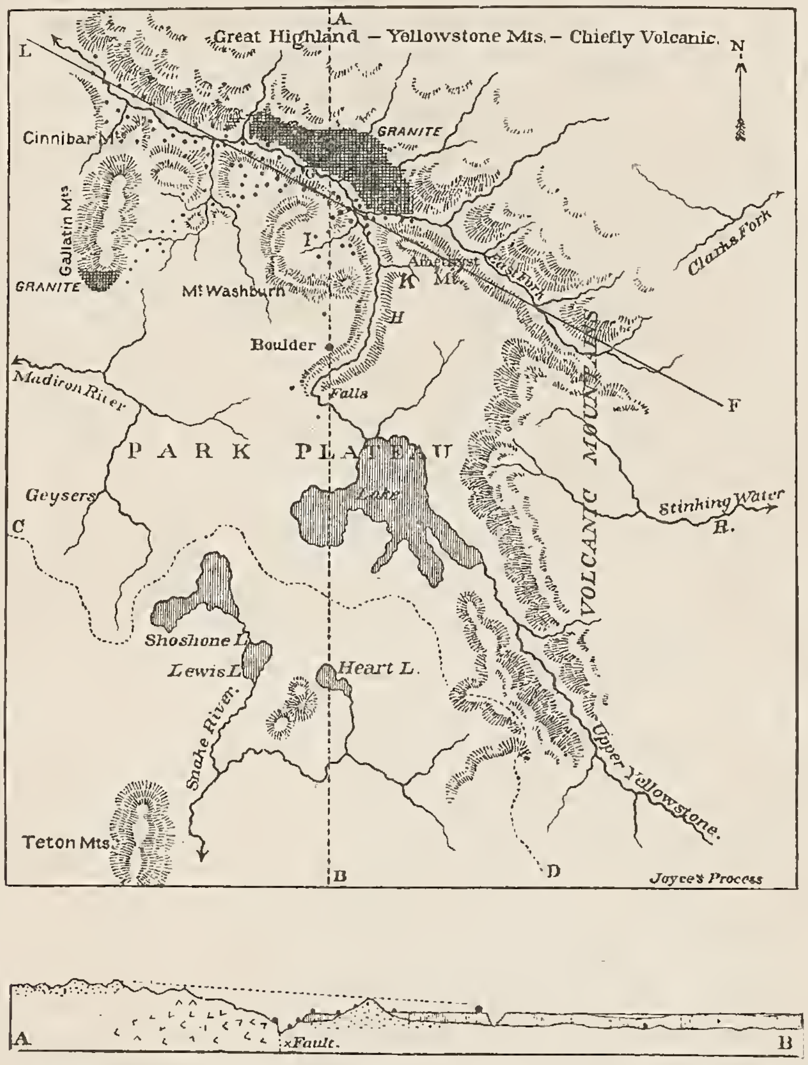

A.
Great Highland – Yellowstone Mts. – Chiefly Volcanic.
N
L
Cinnibar Mt.
GRANITE
Gallatin Mts.
GRANITE
Mt. Washburn
I
Amethyst Mt.
K
H
Clarks Fork
Boulder
Falls
Madison River
F
PARK PLATEAU
Geysers
Lake
VOLCANIC MOUNTAINS
Stinking Water R.
C
Shoshone L.
Lewis L.
Heart L.
Snake River
Upper Yellowstone
Teton Mts.
B
D
Joyce's Process
A
x Fault.
B

Fig. 2. Map of the Yellowstone and Lamar valleys modified from Holmes, plate XXX, 12th Annual Report, U. S. Geol. and Geophys. Surv., part, II, 1878.

A-B: Section showing distribution of glacial bowlders; C-O: Ocean divide; E-F: Line of great fault; G: Third Canyon; H: Grand Canyon; I: Tower Creek; K: Deep Creek (Jasper Creek of Holmes Report).

A study of the map given by Holmes (Fig. 2) to illustrate the distribution of the granite boulders in the neighborhood of the Yellowstone Valley suggested to us another possible explanation of some of the sediments in the canyon. The distribution of the granite boulders is such that the ice appears to

to have come from the North, then from the [illegible].

See new writing of the Canyon part

PROFESSOR HOLMES' RESEARCHES ON THE GEOLOGICAL HISTORY OF THE YELLOWSTONE CANYON.

It is a matter of personal gratification to find my geological work of 1878 in the Yellowstone Park, as recorded in the Hayden Survey Report for 1878 and which has remained unnoticed for fifty years, cited as the most successful interpretation of the geology of the Grand Canyon yet published. The two well known geologists, Professor R. M. Field of Princeton Chair, Dept of Geol University, N.J., and Professor O. T. Jones of Manchester, University, England, who had spent the summer of 1928 in a careful study of the Canyon region, called upon me on their return from the field in the fall to congratulate me on my work there, researches almost forgotten by me, the announcement which caused me to exclaim "Holmes geologically dug up!" 1878 was my last year in Rocky Mountain field geology, archeology and later art having claimed me.

So gratifying is the report of these gentlemen that I am tempted by a modest feeling of triumph to quote the following from their Report published in the AMERICAN JOURNAL OF SCIENCE for March 1929. I may add that this quotation is but one of the several references approving of my interpretations.

... "Upon our return to the east we reexamined the bibliography on the geology of the Yellowstone Park. Since the publication of the Yellowstone Folio in 1905, we could not fine any record that the facts mentioned above had been

noticed by any previous observers. Upon referring to Hayden's Survey of the park in the twelfth annual report for the year 1878, we were surprised and delighted to find that Holmes in his excellent geological description of the northern portion of the park gives abundant evidence both written and pictorial that he had observed several of the important features given in detail later in our paper, and that he was on the verge of reaching the same conclusion as we do. We feel that we could not do better than to quote the following paragraphs from his paper.

' Something of the past history of this Valley can be learned from the facts here observed (at Jasper Creek, now shown on the map as Deep Creek). A stream - whether the Yellowstone or not, no one can say with certainty - had cut down through the Tertiary strata to a depth of 600 feet below the top of the present valley, and about 400 feet above the bed of the present river. The lava has flowed into it, filling the valley to the depth of 200 feet or more. Whether this occurred before or after the flow of the rhyolite I am unable to say from any facts observed, although on general principles we would probably be safe in concluding that it is more recent. The debris at the ends and on the top of the mass of basalt make it difficult to say whether it passes beneath the rhyolite of the main wall of the canyoon

or is simply set against it. The fact that it does not continue across the crater to the right, as seen in the drawing (plate 21, p. 38), proves nothing, as the rhyolite, which extends down the opposite spur to a point considerably below the base of the basalt, may have been deposited either before or after it. I had not time to go on with this interesting investigation or I should, without doubt, have been able to solve the whole problem of the relative ages of all the canyon rocks.'

Again on page 42 he Holmes writes:

'This valley (Junction Valley) is situated in one of the most interesting as well as one of the most beautiful regions in the park. The geologist might find a year's profitable work within a radius of ten miles about Baronett's Bridge, and the tourist could find almost unlimited sources of pleasure. Geographically there are illustrations of many most interesting problems of geological history and the very perplexing events of the volcanic Tertiary period may be studied to the best advantage.

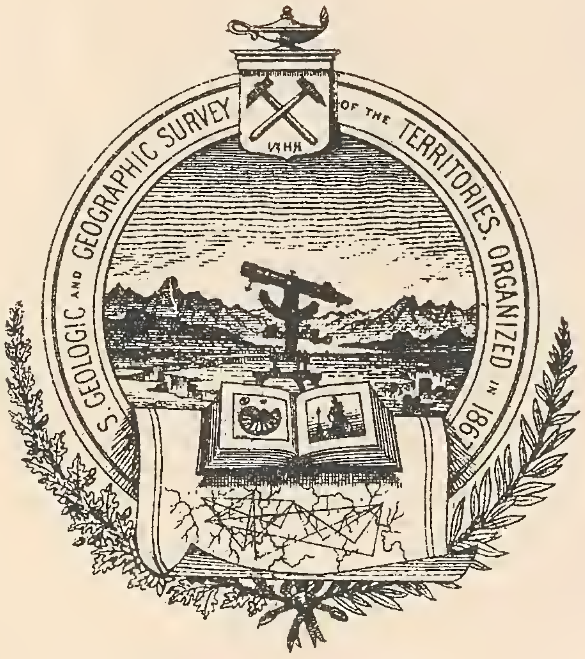
'North of the valley lies the range of Granitic Mountains that must have looked down in succession upon the Eocene, Miocene, and Pliocene Lakes and witnessed the extraordinary events of the volcanic period. Here, during the latter part of the volcanic epoch while the subaerial deposits were in process of formation, the erosion seems to have been

more than usually deep. The trachytes and rhyolites were poured out into the valleys cut in the Tertiary and Paleozoic rocks. Subsequent flows filled in the valleys eroded from the first flows, and so on through the basaltic and conglomerate producing period. On account, however, of the occurrence of so many products together, their relations are hard to make out. This may be remarked of the Tertiary strata, especially the several groups of which cannot easily be distinguished from the conglomerate formed in more recent times through alluvial and volcanic agencies, and possible indentifications are very nearly impossible. Of course, prolonged study may make everything clear.'

"It seems remarkable to the authors of this paper that no attention has been paid to the penetrating observations of Holmes and his colleagues made over half a century ago. The report of 1878 is replete with careful observations and beautifully accurate drawings by this master artist of geological subjects and the scientific interpretation of scenery."

A further citation is as follows: "Taken in conjunction with the section near Red Rock, the arenaceous and argillaceous deposits near the bottom of the canyon probably represent the earlier stages in the filling of the first lake which was formed in this part of the canyon, the final stage of which is the conglomerate group at the base of the Red Rock section. The significance of this deposit did not escape Holmes."

Footnote on the unpublished my little map of the canyon – with the section


U. S. GEOLOGIC AND GEOGRAPHIC SURVEY OF THE TERRITORIES, ORGANIZED IN 1867

TO COMMEMORATE THE AUTHORIZATION AND ORGANIZATION OF THE U. S. GEOLOGICAL SURVEY

FERDINAND V. HAYDEN
Pioneer Geologist

Authorized by Congress
March 3, 1867

December 13, 1930
Eleventh and Pennsylvania Ave.
Washington, D. C.

FERDINAND VANDEVEER HAYDEN (1829–1887)

American Geologist, was born at Westfield, Mass., on September 7, 1829. He graduated from Oberlin college in 1850 and from the Albany medical college in 1853 where he attracted the attention of Prof. James Hall, State geologist of New York, through whose influence he was induced to join F. B. Meek in an exploration of the "Bad Lands" of Dakota to make collections of fossils. The next two years were spent in a similar exploration of the Upper Missouri under the auspices of the American Fur Co., resulting in the discovery of an important collection of fossils, which was afterwards divided between the academies of science of St. Louis and Philadelphia. In 1856 Lieut. G. K. Warren appointed him one of his assistants in the exploration of the Yellowstone and Missouri Rivers and of the Black Hills. In 1859 he was attached to Capt. W. F. Raynolds' expedition to the upper tributaries of the Yellowstone as surgeon and naturalist, one result of which was his *Geological Report of the Explorations of the Yellowstone and Missouri Rivers in 1859–60* (1869).

During the Civil War Dr. Hayden was actively engaged as surgeon in the Federal army from 1862 to 1865, resigning to become professor of mineralogy and geology in the University of Pennsylvania, which position he retained until 1872. In 1867 he was appointed geologist in charge of the U. S. geological and geographical survey of the territories and from his twelve years of labor there resulted a most valuable series of volumes in all branches of natural history and economic science; and he issued in 1877 his *Geological and Geographical Atlas of Colorado*. Upon the reorganization and establishment of the U. S. Geological Survey in 1879, he acted for seven years as one of the geologists. He died at Philadelphia on December 22, 1887.

His other publications were: *Sun Pictures of Rocky Mountain Scenery* (1870), *The Yellowstone National Park*, illustrated by reproductions of water color sketches by Thomas Moran (1876), *The Great West; its Attractions and Resources* (1880). With F. B. Meek he wrote (*Smithsonian Contributions*, vol. 14, Art. 4) "Paleontology of the Upper Missouri, pt. I, Invertebrate." His valuable notes on Indian dialects are in *The Transactions of the American Philosophical Society* (1862), in the *American Journal of Science* (1862) and in *The Proceedings of the American Philosophical Society* (1869). With A. R. C. Selwyn he wrote *North America* (1883) for Stanford's Compendium.

Obituary notice of Dr. Hayden read before the American Philosophical Society by Prof. J. P. Leslie.

He represented in science the curiosity, the intelligence, the energy, the practical business talent of the western people. In a few years they came to adopt him as their favorite son of science. He exactly met the wants of the Great West. There was a vehemence and a sort of wildness in his nature as a man which won him success, cooperation, and enthusiastic reputation among all classes, high and low, wherever he went. * * * He popularized geology on the grandest scale in the new States and Territories. He easily and naturally affiliated with every kind of explorer, acting with such friendliness and manly justice toward those whom he employed as his co-workers that they pursued with hearty zeal the development of his plans.

I think that no one who knows the history of geology in the United States can fail to recognize the fact that the present magnificent United States Geological Survey * * * is the legitimate child of Doctor Hayden's Territorial Surveys.

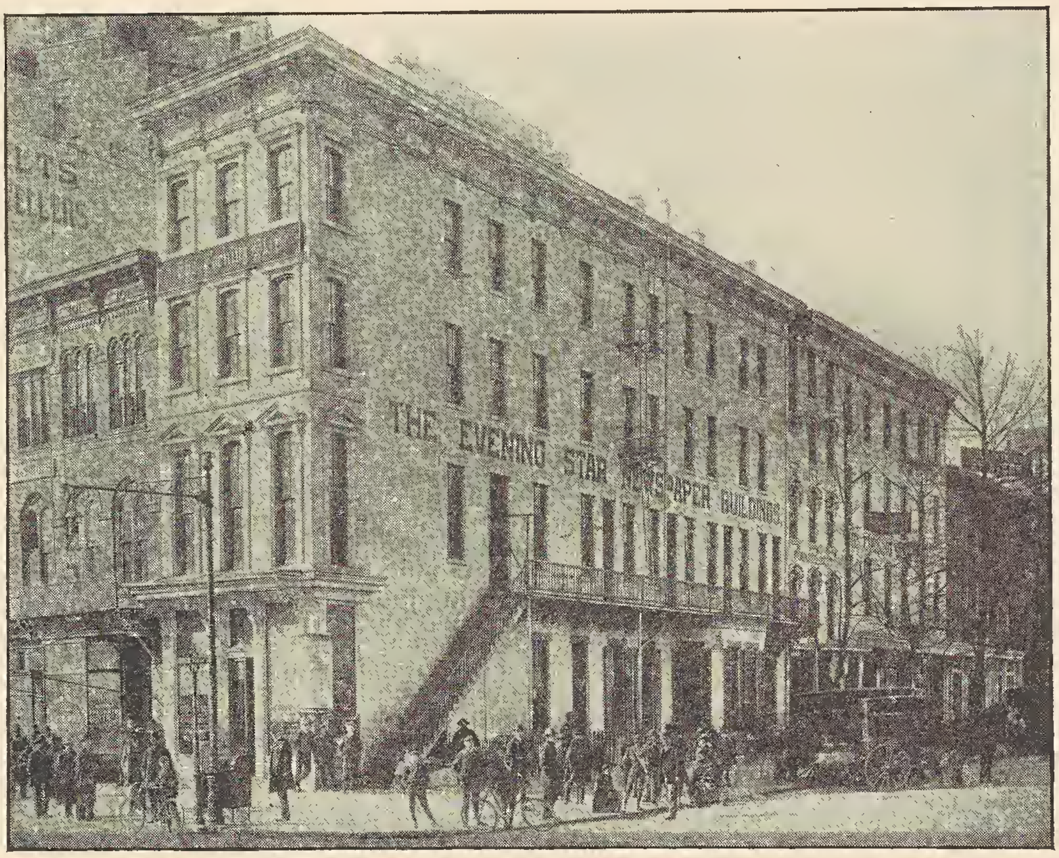
—Extracts from Encyclopaedia Brittanica, New International Encyclopaedia, and Merrill's Contributions to the History of American Geology.

THE SURVEY STAFF

U. S. Geological and Geographical Survey of the Territories
F. V. Hayden, U. S. Geologist in Charge

Adams, Robert Jr., Assistant Quartermaster
Batty, J. H., Naturalist
Bechler, G. R., Topographer
Berthoud, E. L., Civil Engineer
Brooks, Eli, Civil Engineer
Carpenter, Lieut. W. L., Naturalist
Chittenden, George B., Topographer
Cope, Prof. E. D., Naturalist
Coues, Dr. Elliot, Ornithologist.
Coulter, John M., Botanist
Endlich, Dr. F. M., Geologist
Gannett, Henry, Topographer
Gardner, James T., Geographer
Holman, William S. Jr., General Assistant
Holmes, William H., Artist and Assistant Geologist
Ingersoll, Ernest, Zoologist
Jackson, William H., Photographer
Ladd, S. B., Topographer
Leidy, Prof. Joseph, Naturalist
Lesquereux, Leo, Paleontologist
Luce, E. T., General assistant.
Marvine, A. R. Geologist
Meek, F. B. Paleontologist
Nealy, S. H. General assistant
Newberry, Prof. J. S., Geologist
Owen, F. D. Assist. Topographer and Artist
Packard, A. S., Naturalist
Peale, A. C., Geologist
Pearson, —— Financial clerk
Porter, T. C., Botanist
Rhoda, Franklin, Assistant Topographer
Smith, S. I., Naturalist
Stevenson, James, Administrative Chief
Steckle, Henry W., Assistant Topographer
Taggart, W. Bush, Assistant Geologist
Thomas, Prof. Cyrus, Publications
Verrill, H. E., Zoologist
White, C. A., Paleontologist
Whitney, Prof. W. D., Philologist
Wilson, A. D., Topographer

For Field Work—Guides, Hunters, Packers and Cooks were added to each division.



Eleventh Street and Pennsylvania Avenue,
Washington, D. C.
Headquarters of the U. S. Geological Survey
F. V. Hayden, Geologist in Charge
The offices were in the upper part of the building, reached by the outside stairway
This building was demolished in April, 1899
Subsequently, about 1875, rooms were occupied at 509 Seventh Street N. W.

SURVIVING MEMBERS

Dr. Wm. H. Holmes
George B. Chittenden
Ernest Ingersol
Wm. H. Jackson
S. B. Ladd
Frederick D. Owen

Order of Exercises

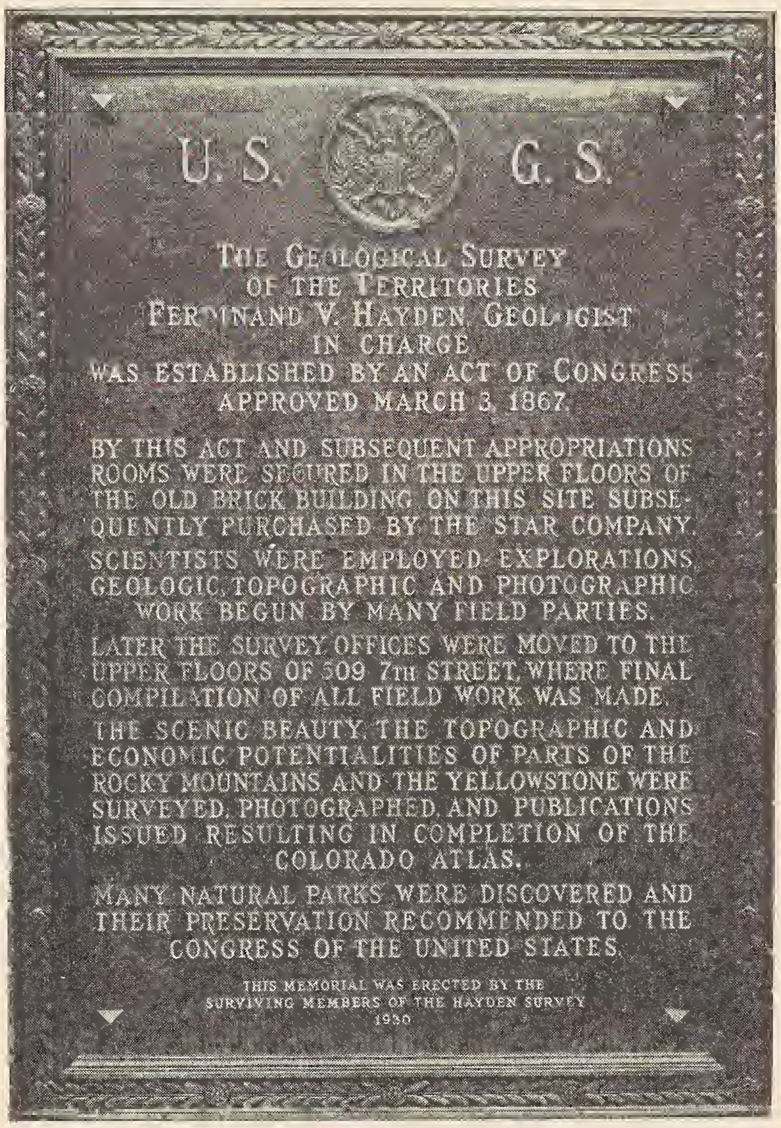
December 13, 1930

⁂

Dr. Wm. H. Holmes or Wm. H. Jackson, Presiding
and will present the tablet

Addresses by
Hon. Guy V. Hardy, M. C., Colorado
Hon. Edward T. Taylor, M. C., Colorado
Dr. Edgar L. Hewett, President Archaeological Institute of America

the memorial will be unveiled by
Frederick D. Owen



U. S. G. S.

THE GEOLOGICAL SURVEY
OF THE TERRITORIES
FERDINAND V. HAYDEN, GEOLOGIST
IN CHARGE
WAS ESTABLISHED BY AN ACT OF CONGRESS
APPROVED MARCH 3, 1867.

BY THIS ACT AND SUBSEQUENT APPROPRIATIONS
ROOMS WERE SECURED IN THE UPPER FLOORS OF
THE OLD BRICK BUILDING ON THIS SITE SUBSEQUENTLY PURCHASED BY THE STAR COMPANY.

SCIENTISTS WERE EMPLOYED, EXPLORATIONS
GEOLOGIC, TOPOGRAPHIC AND PHOTOGRAPHIC
WORK BEGUN BY MANY FIELD PARTIES.

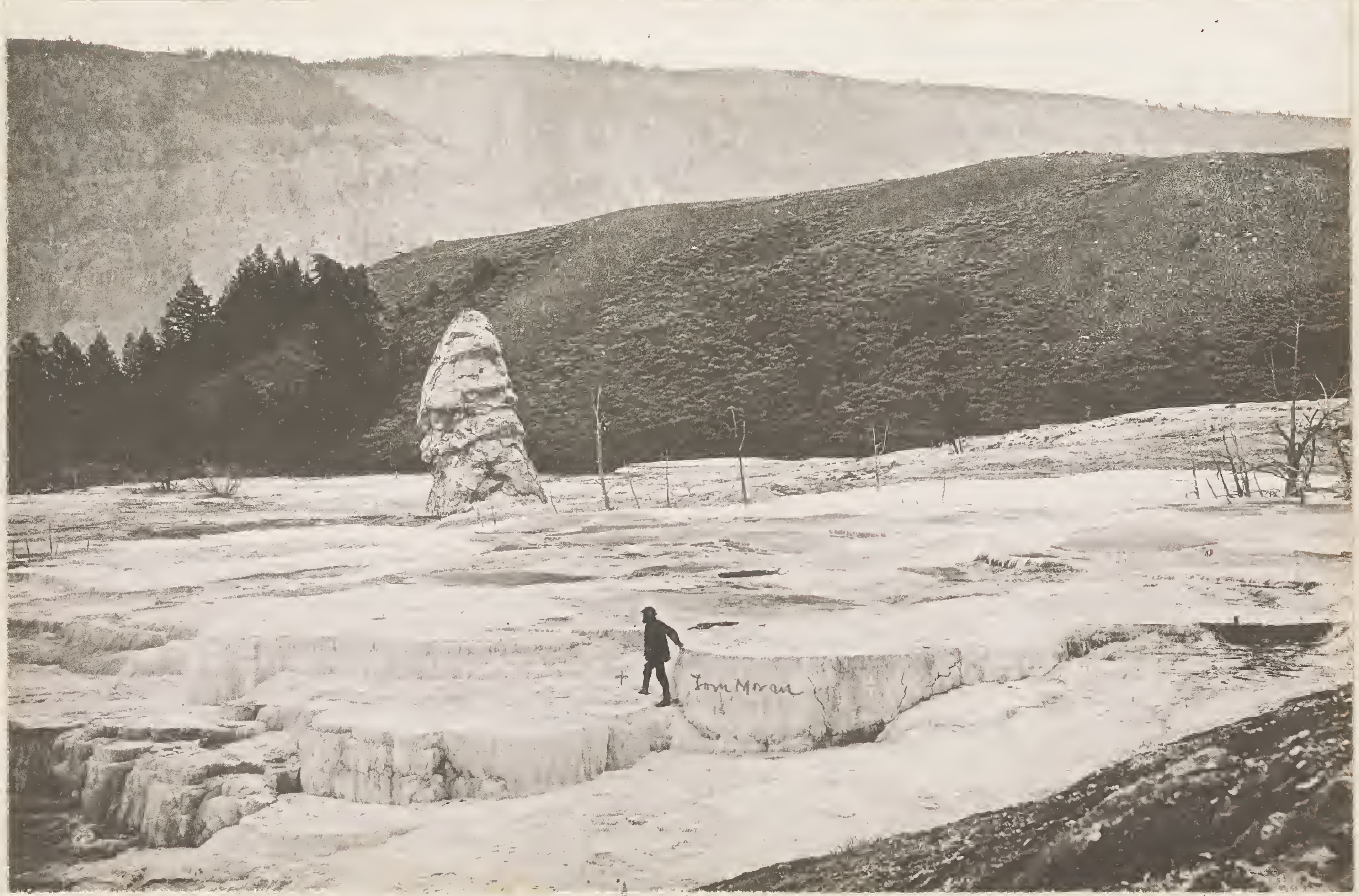
LATER THE SURVEY OFFICES WERE MOVED TO THE
UPPER FLOORS OF 509 7TH STREET, WHERE FINAL
COMPILATION OF ALL FIELD WORK WAS MADE.

THE SCENIC BEAUTY, THE TOPOGRAPHIC AND
ECONOMIC POTENTIALITIES OF PARTS OF THE
ROCKY MOUNTAINS AND THE YELLOWSTONE WERE
SURVEYED, PHOTOGRAPHED, AND PUBLICATIONS
ISSUED RESULTING IN COMPLETION OF THE
COLORADO ATLAS.

MANY NATURAL PARKS WERE DISCOVERED AND
THEIR PRESERVATION RECOMMENDED TO THE
CONGRESS OF THE UNITED STATES.

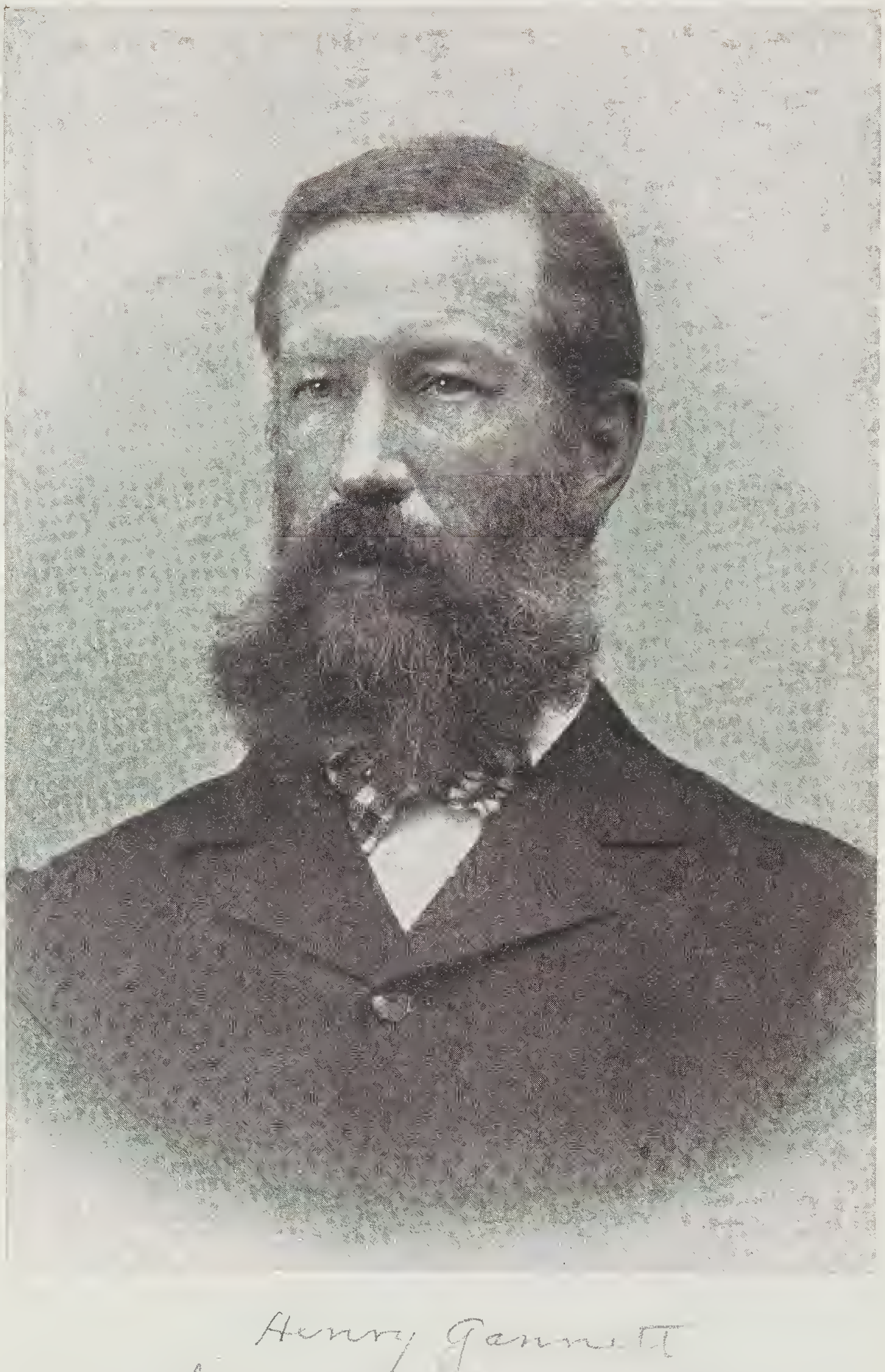
THIS MEMORIAL WAS ERECTED BY THE
SURVIVING MEMBERS OF THE HAYDEN SURVEY
1930

ERECTED
In the main office, ground floor
The Evening Star (new building)
Eleventh Street and Pennsylvania Avenue N. W.
Washington, D. C.
On behalf of the Surviving Members of the Survey



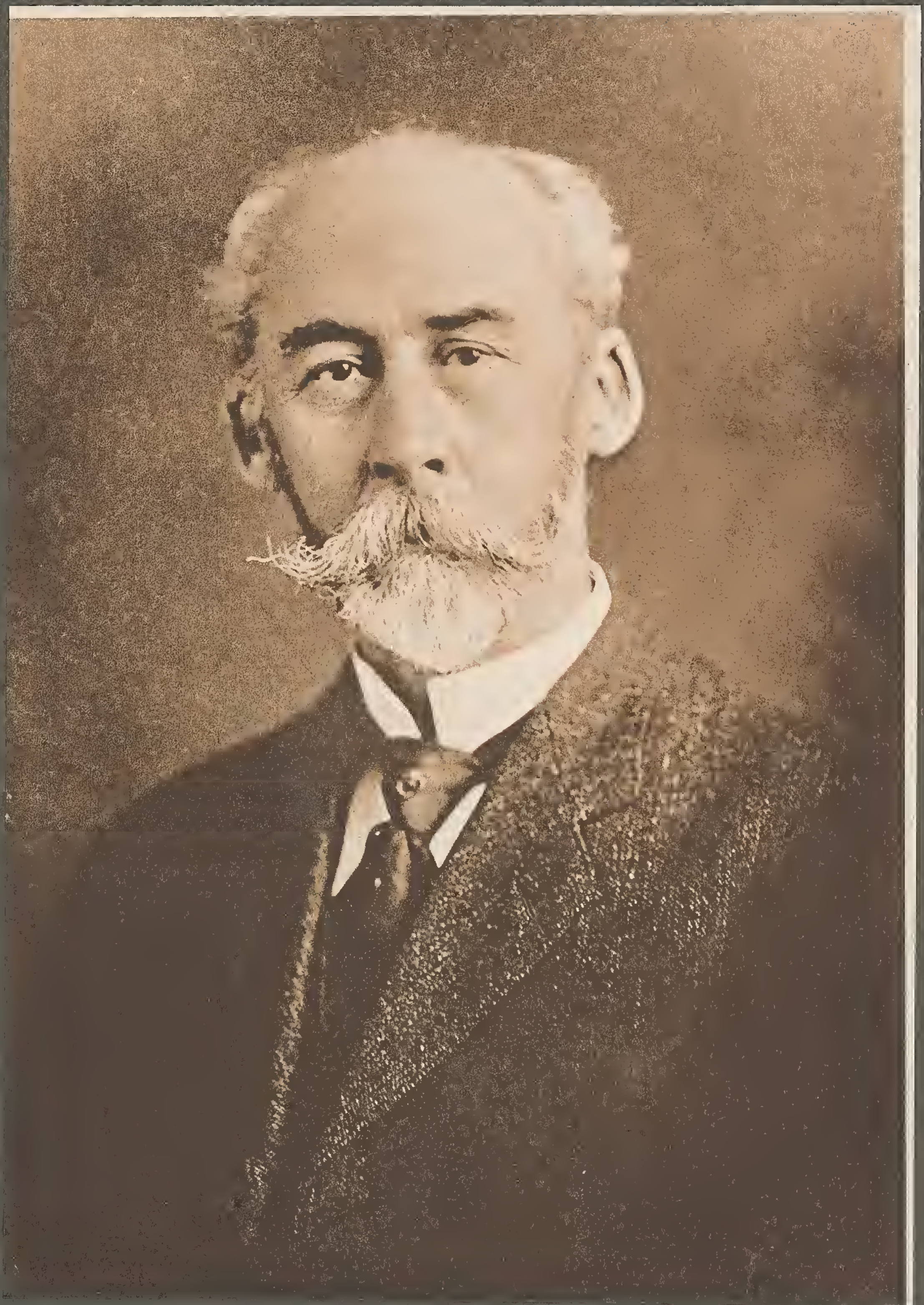
Moran

Mammoth Hot Springs, the [illegible]
and the "Liberty Cap", an extinct geyser cone



Henry Gannett
who named, with Hayden's Consent
Mt Holmes, Yellowstone park
after me. 1878

Penned about 40 years later



Holmes
about 40 generations,

By A.P LACEY. Lawyer & home friend Cadiz Sentinel. 1877
Barnesley Bldg
F4218

①

Column 2

W. H. HOLMES, THE ARTIST.

Mr. W. H. Holmes, son of Joseph Holmes, of Short Creek township, this county, is winning a reputation in Hayden's scientific party, in the employ of the Government. We publish the following private letter from Maj. Robert S. Lacey, of Washington, D. C., from which we are pleased to know that Mr. Holmes is being appreciated for his talents. In addition to the elegant pictures spoken of we have some twenty smaller photographic views which are superb.

WASHINGTON, D. C., Sept. 25, 1877.

DEAR ARNOLD:—

I herewith send you by Pat Haverfield, the photographs of Colorado scenery I promised Mrs. Arnold last spring. I hope she will be pleased with them, as I regard them as very fine indeed. The waterfall is one of the best combinations of forest and stream that I ever saw, and one, in looking at it, cannot repress the query, how did the artist succeed so admirably in effecting it? No. 2 is intended to give the spectator a view at the head of a canon, at a point where the timber ceases to grow, so that the eye may catch a range of peaks and the huge banks of snow which lie in the ravines throughout the year. These peaks are nearly 14,000 feet above the level of the sea, and when a visitor climbs upon them he fully realizes he is in the region of everlasting snow, and is where the hand of man can never enter to transform to his wishes. Standing at the timber line, in the foreground of the picture, you are about 12,000 feet high, and this canon in its absence of trees, and the gradual disappearance of vegetation up to the point where snow and naked rock are met, with the clear outlines of the peaks against the sky, presents you a view which you may see everywhere in the Rocky Mountains. The snow falls in such places at all seasons of the year. I was driven down from the top of Gray's Peak in the middle of August by as fierce a snow storm as I ever encountered, and yet at timber line the air was as serene and pleasant as the sun could make it in such elevated places.

No. 3 is one of the Mountain Lakes often found among the peaks, and is an excellent combination of light and shadow.

These pictures seem to me to be the perfection of the photographic art and it is difficult to appreciate how the artist could take them of such immense size, knowing that all his apparatus and working material had to be transported upon the backs of small mountain jacks. No vehicle of any nature can climb the rugged mountains. Horses cannot endure the rarified air, hence there is no alternative but to use the diminutive donkey for every purpose. These docile, sure-footed animals will, in trains of a dozen, follow each other in single file, in the narrow zig-zag paths to the highest peaks, and in places where horses would prove powerless, carry enormous burdens and enjoy themselves; hence they are to the mountaineer what the camel is to the Arabian, an absolute essential on which he relies as a carrier for every necessary of life.

These photographs were taken by Wm. H. Jackson, the photographer of Prof. Hayden's Survey, and they unmistakably exhibit his rare skill in the perfection with which every detail is shown of shade, sky, bushes, twigs, water and every outline that may be seen by the visitor on the ground. It is impossible, of course, to appreciate what nature has there of the sublime by looking at a photograph, yet we feel assured no artist living can succeed better than Mr. Jackson has, in making nature's counterfeit in these pictures.

Connected with Prof. Hayden's survey is another true artist, Wm. H. Holmes, a Harrison county boy. Prof. Hayden's genius is as much shown in his selection of men for assistants as in his scientific attainments, and we are glad to note that Shortcreek Tp. has in Mr. Holmes furnished him one of his most talented aids. Mr. Holmes came here several years ago, taking a mere subordinate draftman's position in the Smithsonian Institute, but, developing rare merit, he soon was promoted. He has served under Prof. Hayden as field draughtsman and geologist and has no superior here for either duty.

He is a thorough master of the pencil and water color. His topographical and geological maps cannot be surpassed, while his written articles which appear in the Annual Reports of Prof. Hayden to Congress, and in the Literary Magazines of the East show him to be as much at home with a pen as with pencil and dividers. We are very proud of him here, and feel assured he will make his mark. We will hardly allow Steubenville to take him, though fully aware of the necessity which impels that benighted city to absorb Harrison county talent. Put Holmes down as another Harrison county boy who has gone out into the world and made himself a reputation.

Prof. Hayden's entire force is composed of young men like Holmes. Older men prove unable to endure the fatigues and hardships of mountain work, and are kept in the office here while the young men must put on their harness and go out into the field until they have acquired full right for post duty.

R. S. LACEY.

Column 1

NEW VOICE,

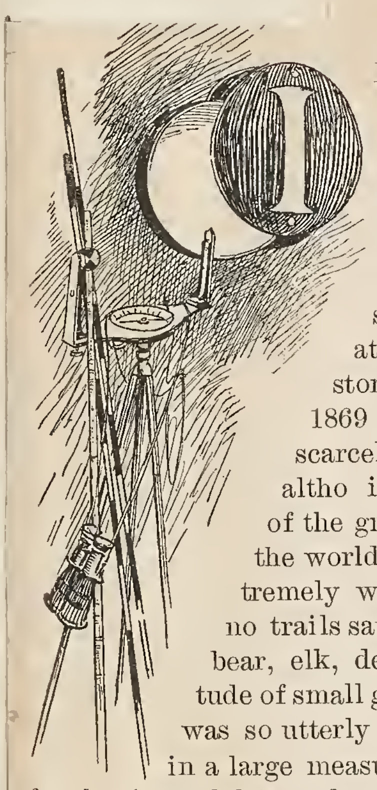
ARY 28, 1899.

(88)

TRUE TALES
By
AMERICAN EXPLORERS

Naming the Rocky Mountains

By W. H. Holmes of the Smithsonian Institute *



I BEGAN my exploring career with the old Geological Survey of the Territories in 1872. This was the first systematic exploration of the Yellowstone country. Up to 1869 this region was scarcely known at all, altho it contained some of the greatest wonders in the world. It was an extremely wild country, with no trails save those made by bear, elk, deer, and a multitude of small game. The region was so utterly wild that we had in a large measure to find names for the rivers, lakes, and mountain-peaks. It is interesting now to go back over that time and recall the incidents leading to the use of many of the names given.

It was a melancholy duty of the party in 1872 to follow the body of Lady Blackmore, wife of the great traveler, Sir William Blackmore, who accompanied us that year, to a humble grave at the base of the great range of mountains known as the Gallatin Range. Afterward, eight days were spent in ascending one of the snow-capped peaks, that it might be appropriately dedicated as Blackmore Peak. The name Mount Evarts was attached to a massive mountain mass that lies just across Gardiner's River from Mammoth Hot Springs because it was the site of the rescue of the nearly starved and quite crazed explorer of that name, who was lost in the wilds of the upper Yellowstone country for 37 days three years before. Later in the days of exploration it gave me especial pleasure to be able to attach to the charming valley containing the mud geyser and other wonders of the Park, the name of Hayden.

I had a curious little bear experience in the Gallatin Range when I was with the first Hayden expedition. We started out to climb one of the mountains, one party going in one direction, and the other with the outfit in another direction. As we went along we saw much small game and frequently tracks of mountain lion, bear, deer, and elk. I was forging along alone on my tired little pony, when suddenly I saw a large black object just ahead. I thought at first it was a horse, but finally made it out to be a large black bear rooting in the snow. I was armed with a pistol only, and, deciding that discretion was the better part of valor, beat a hasty and perhaps undignified retreat. Securing reenforcements later, I returned to seek his bearship, but he had disappeared. Then I found by examination of his tracks in the snow that at the very moment I had started in one direction the bear had started in the opposite direction, and with such remarkable impetuosity as to clear 12 feet at a jump. My chances of escape would have been very small if he had decided to come my way. We followed his trail and came upon him in a deep ravine, where he was finally captured.

In 1874 we were in Colorado, and I recall with pride the fact that within three months I climbed 11 peaks, each over 14,000 feet in height. These were Gray's, Torrey's, Long's, Pike's, and Grizzly peaks, Mts. Evans, Powell, Culebra, Sierra Blanco (14,440 feet high, the highest in the Rockies), Lincoln, Laplata Peak, and Snow Mass Mountain. Many other less important peaks were climbed, among which was the mountain of the Holy Cross.

The ascent of this peak was a very interesting and exciting experience. The mountain is so called from the fact that it has on one of its faces great cross crevices—one vertical, and the other crossing it horizontally

Begins in 1872 and ends in 1875

near the top. The vertical portion is over 600 feet in height. The snow and ice remain in these crevices thruout the summer, becoming a little discolored, and therefore not so plainly visible in autumn, but brightening up again when snow falls, which is every month of the year. We saw the cross first from a range far away to the east. It was distinctly seen against the dark granite face of the mountain, which loomed up in the mirage effect to a marvelous height.

Later we found a creek which we knew must come down from the face of the peak, if not from the very foot of the cross. Climbing was very difficult; a thick virgin forest extending in a belt several miles wide across the base had to be traversed before we reached the final ascent. There we had to stop our animals and proceed on foot. Dr. Hayden, who was always a reckless climber, had the misfortune to fall into one of the mountain torrents crossed during the ascent, but was rescued without much difficulty, and pushed forward with the rest.

Then it began to rain, so that we could see nothing, and we resolved to camp over night, tho we had started out with no provisions but a small lunch. We made our fires at the timberline, 2,000 feet below the summit, and whiled away the weary hours telling stories and watching the bright speck of light made by the camp-fire of our photographer, W. H. Jackson, who was storm-bound on the ridge to the east.

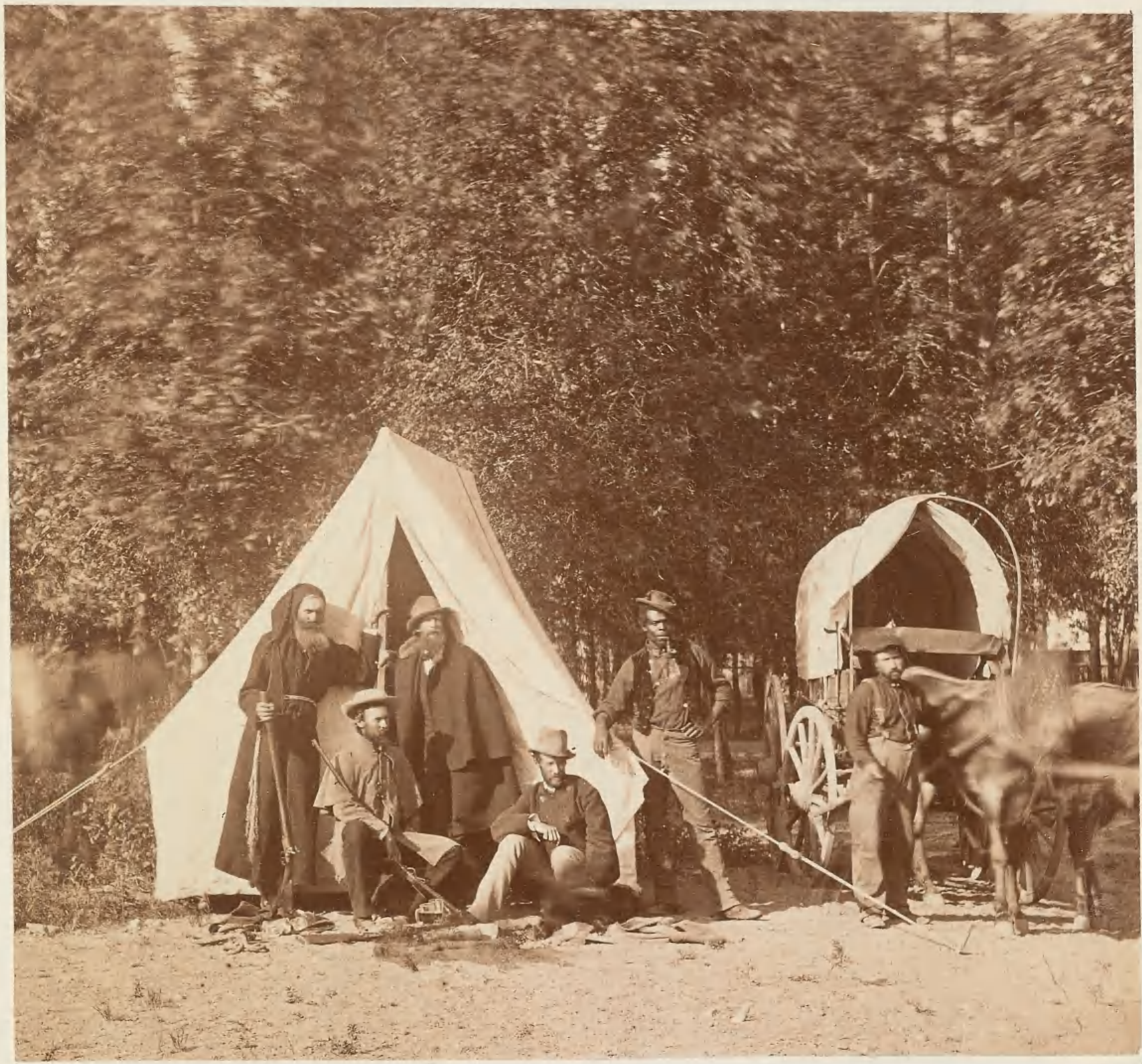
In the morning, breakfastless and weak, we reascended the mountain. By this time the clouds had parted so that many summits were in sight. As we stood on the narrow rocky summit we sought the upper end of the stem of the cross, and found that it occupied a long straight gulley, and consisted in the main of whitish glistening ice. Our photographer, from the opposite ridge, got some excellent views of the cross, and these have been the basis for almost all the illustrations of the mountain and cross which have since appeared. Some time afterward the artist Thomas Moran went out and painted the mountain, the cross, and the roaring torrents with wonderful truthfulness and skill.

A notable episode of the descent of this peak was the wonderful storm effects. The sun at our backs broke thru the clouds, and there was immediately projected on the mists that filled the dark gulf to the east a brilliant rainbow—not the arch as usually seen, but the entire circle—a spectral ring, with our shadows thrown across the lower half, our heads appearing in the center. This mountain is in Central Northern Colorado, some 20 or 30 miles from Leadville, the site of this mining town being then a dense forest. This was in 1874, and in passing I tapped with my geological hammer on some of the ledges of rusty ore about which a few years later more than 10,000 people had assembled.

I have had some unpleasant experiences with Indians. I remember one especially in connection with a pretty tough lot of savages then infesting the cliff-house region. One night our party of six encamped on the river-bottom far down in Utah. For some reason we did not set a guard, but "hobbled" our mules, and turned them out to graze with the bell-horse as leader. This leadership of the bell-horse is a strange thing. Explorers and travelers know well that if a bell is put on a horse in a herd, the rest of the animals, particularly if they are mules, will take a strong fancy for him, and follow

Yellowstone 1871

I was not with the survey this year. These photos serve to show the personnel of the party for their first year



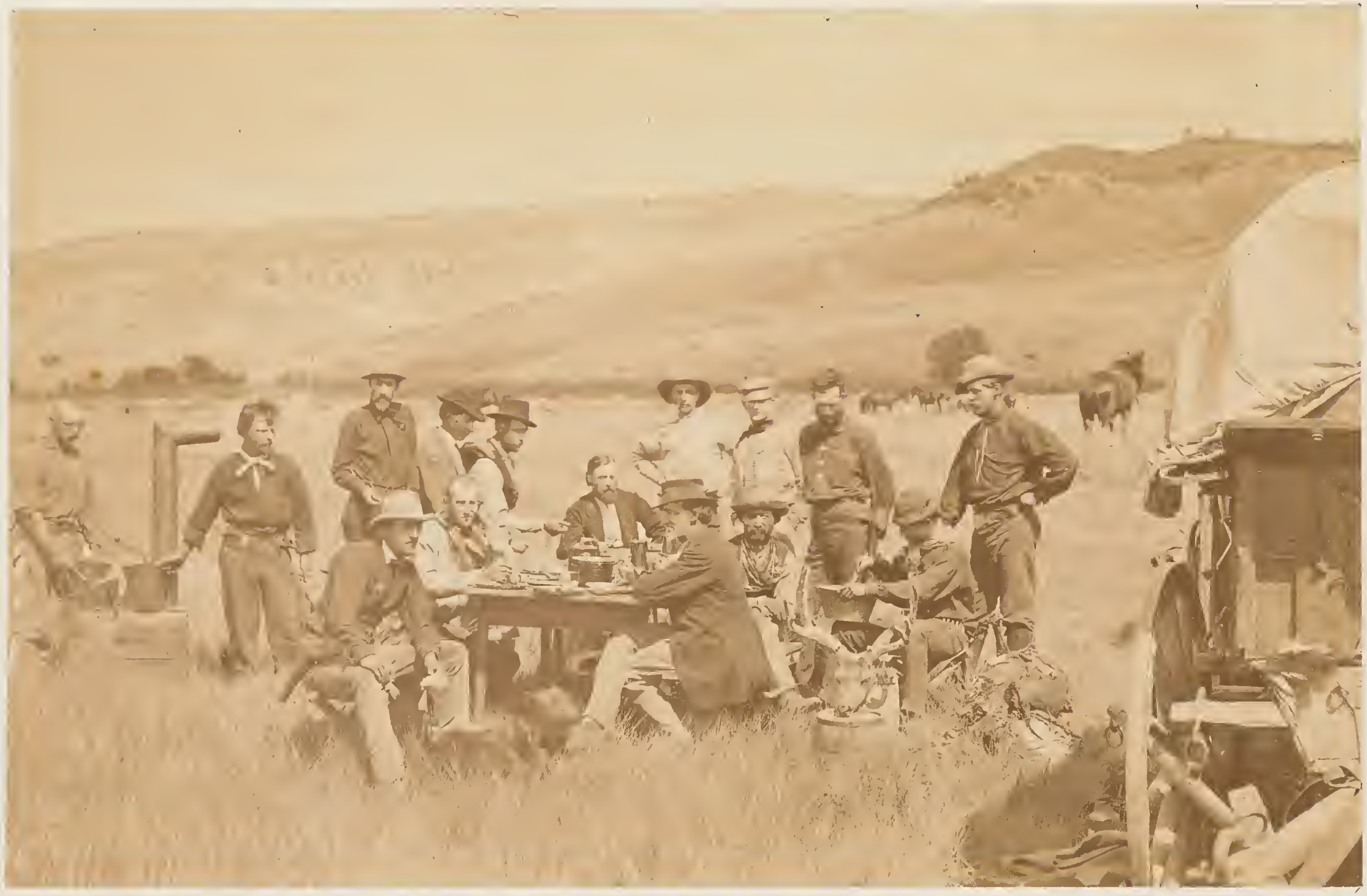
Gov. Langford   Stevenson, manager

Col Woods   Tom Moran
(guest)   artist, guest)

Hayden Survey 1871

Mus. Reg. No. 32113-E.

Yellowstone 1870



Hayden party

The cook

Sanford Gifford, artist

Stevenson

Elliott

Hayden

Smith

Jackson

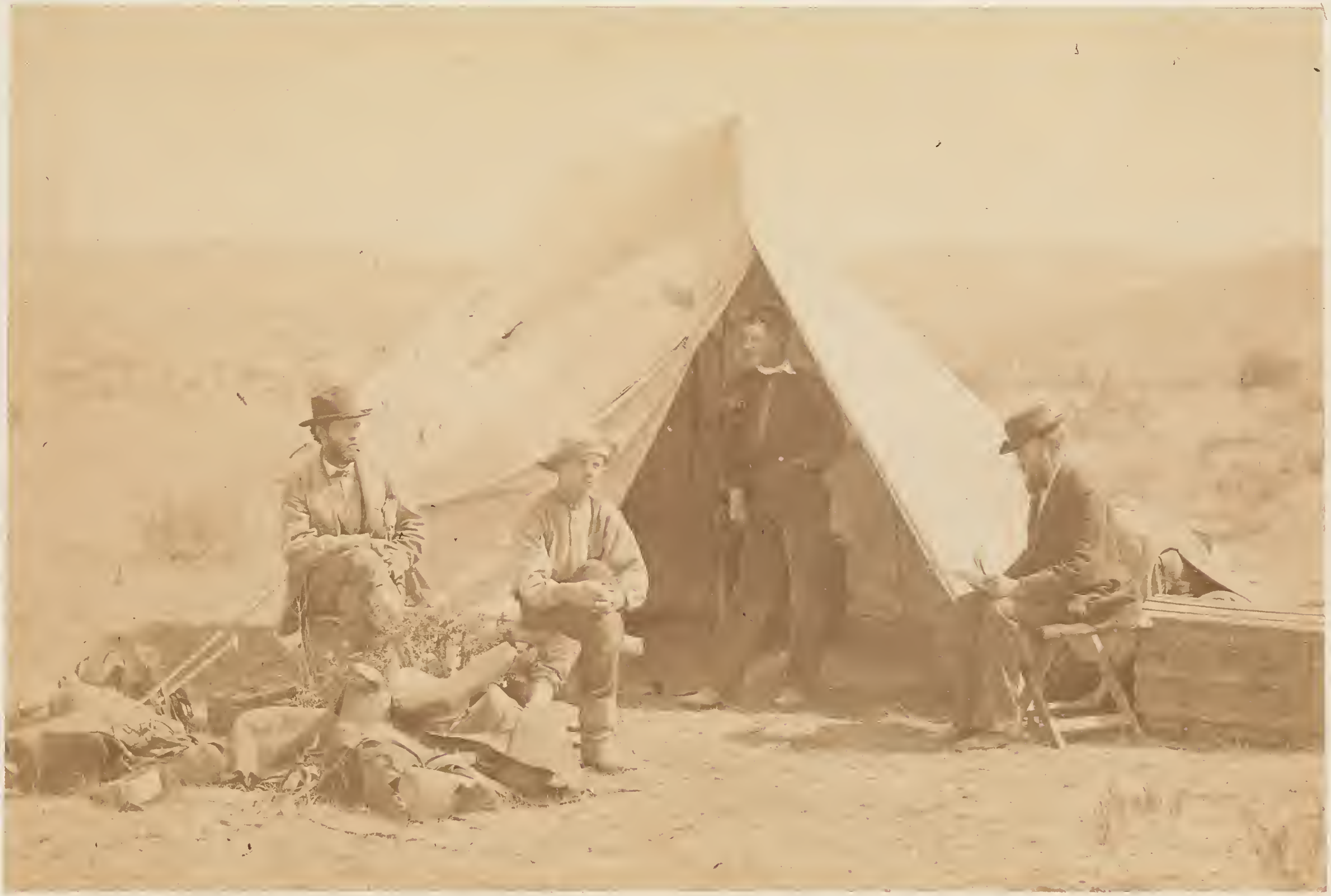
Beaman

Thomas

Turnbull

Gifford, R. Swain, the artist

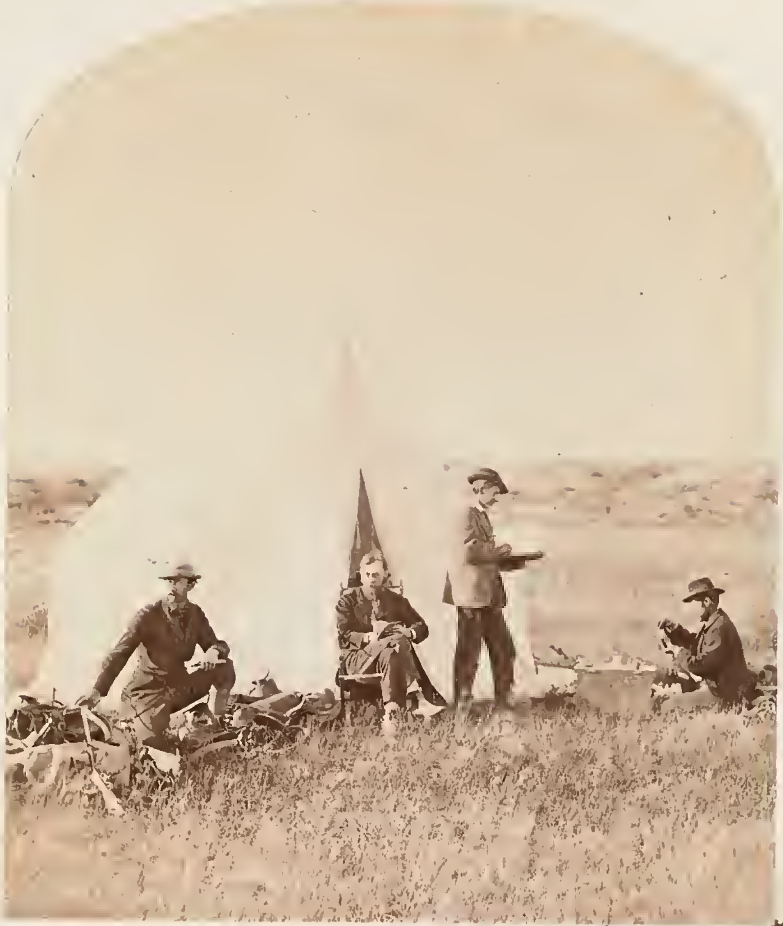
Yellowstone, 1871



James Stevenson Senator Dawes's son Henry Elliott, Dr. F.V. Hayden, chief

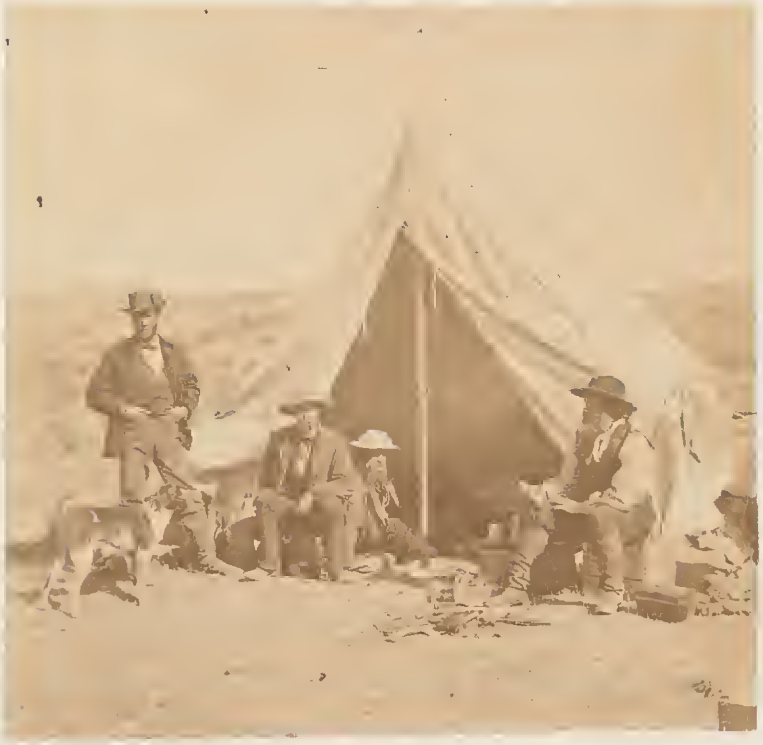
Hayden Survey, Yellowstone
1871 The year before I joined the Survey
I am still in the service
after 54 years

W H Holmes



[illegible] Sanford Gifford, Dr Hayden, James Stevenson,
Henry Elliott

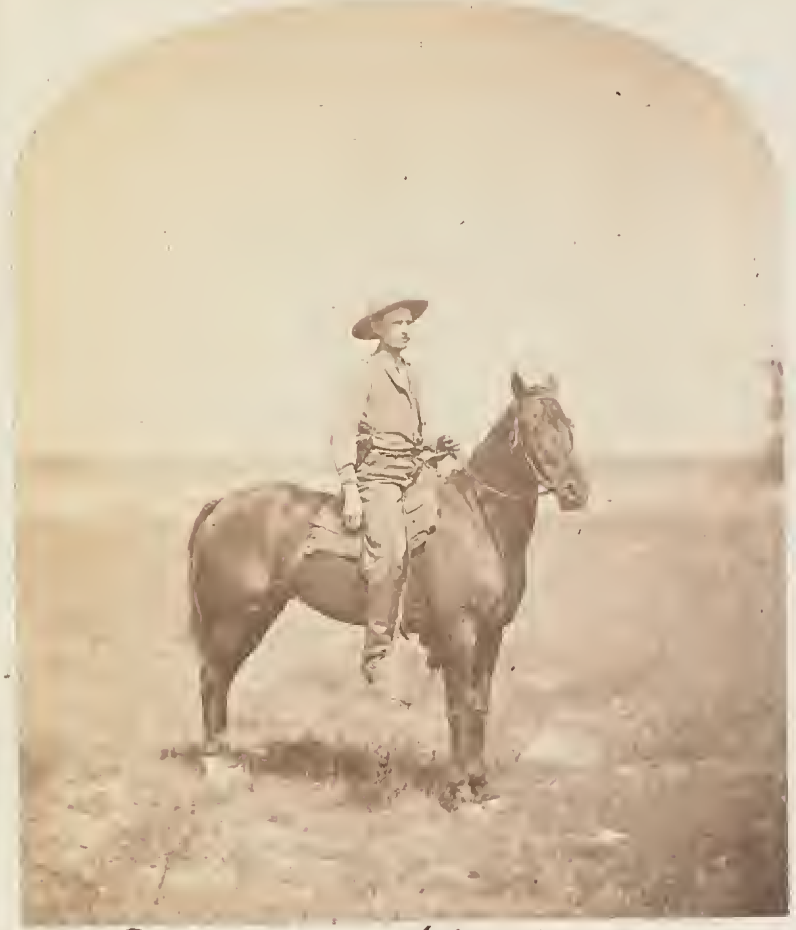
Hayden Survey 1871



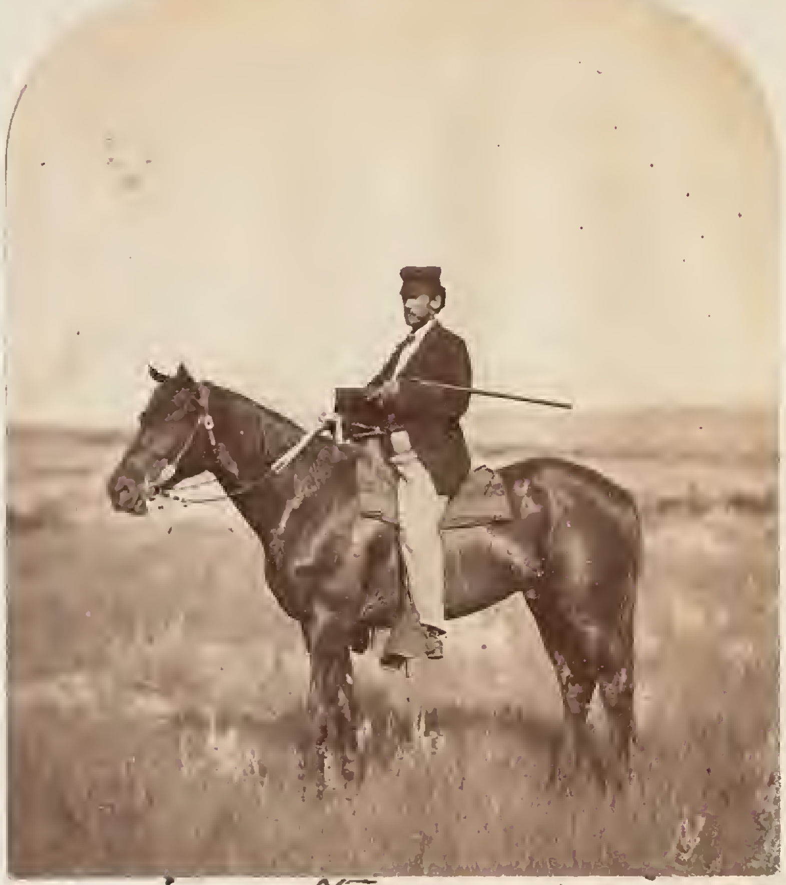
James Stevenson
Bert adams Mr Curtis.
Prof. Bradley.

Hayden Survey 1871

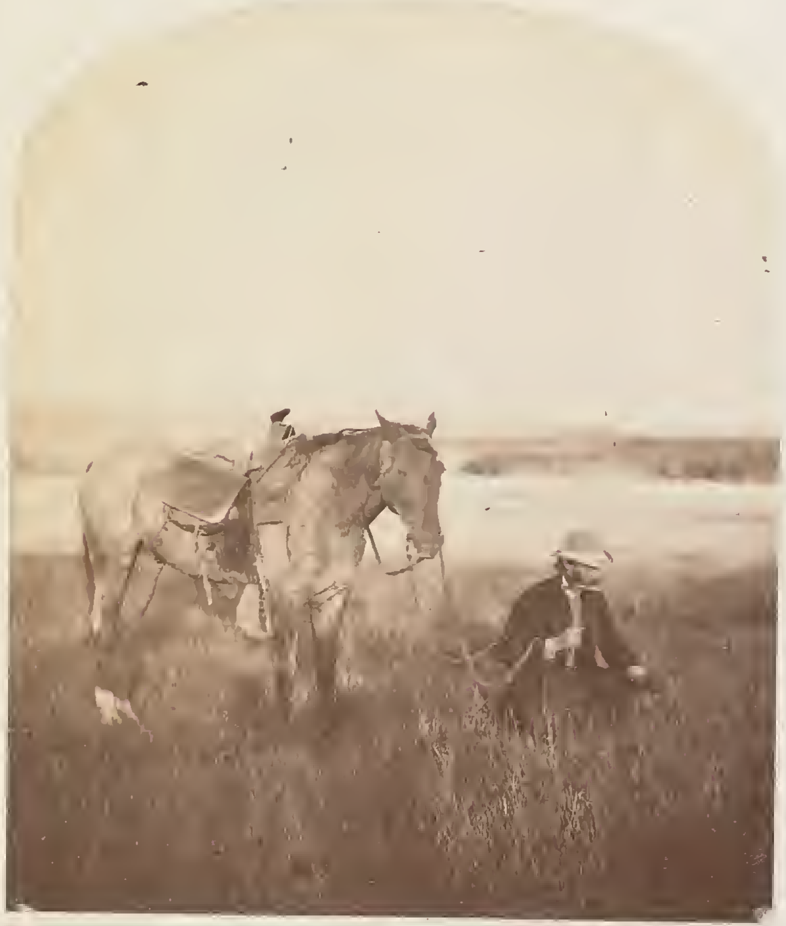
Yellowstone 1871



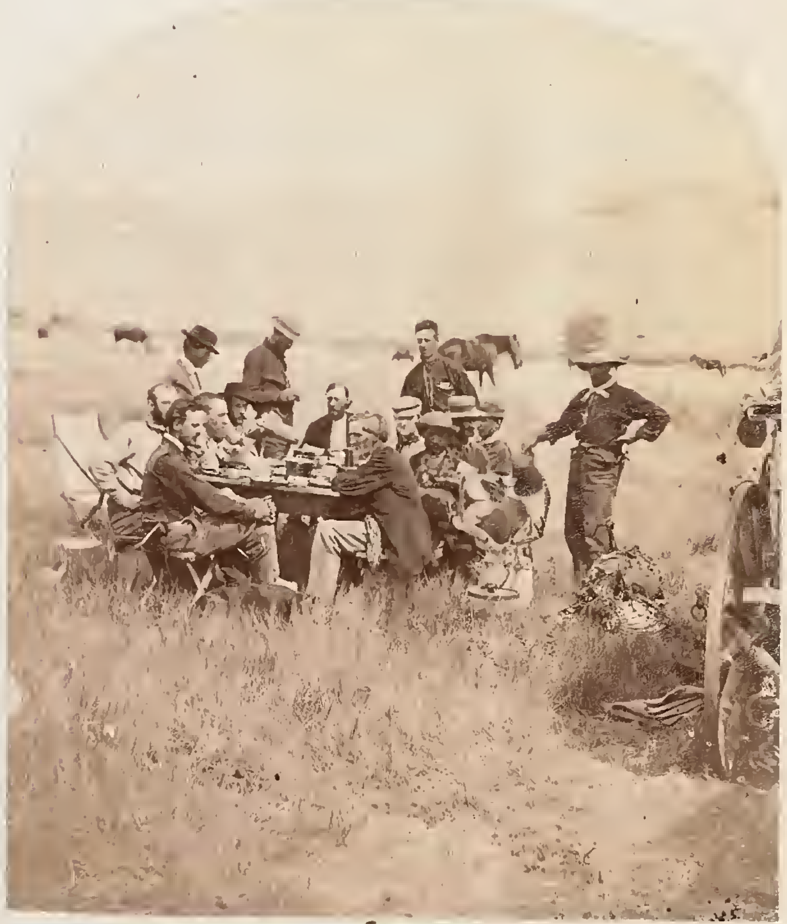
Steve Hovey. Chief packer 1871



James Stevenson, business assistant 1871



Dr Hayden 1871



1871

Turnbull

Hayden

Beaman Thomas Smith

Elliott Jackson

Gifford

Stevenson

W H Holmes

See Wratt 1878 . with Wilsons party

RANDOM RECORDS OF A LIFETIME
DEVOTED TO SCIENCE AND ART, 1846-1931

BY W. H. HOLMES

LIST OF VOLUMES

Volume I. Brief Biography, Positions Held, Loubat Prizes, Medals, etc., Societies and Clubs, Bibliography.

II. Explorations, Episodes and Adventures, Expositions and Congresses.

III. Part I, Yellowstone Explorations, 1872.
Part II, Yellowstone Explorations, 1878.

IV. Part I. Colorado Explorations, 1873, 74, 75, 76 & 87.
Part II. The Cliff Dwellers.

V. Europe 1879-80; Grand Canyon of the Colorado; Explorations in Mexico with Jackson and the Chains; Colorado with Powell and Langley, 1887.

VI. Aboriginal Bowlder Quarries, Piney Branch, D. C., Soapstone Quarries, Paint Mines, and Lay Figure Groups.

VII. The Chicago Venture, University Exposition, Field Museum, Yucatan, Return to Washington, 1892-97.

VIII. Cuba with Powell; Jamaica with Langley; Mexico with Gilbert and Dutton; California with McGee; Physical Anthropology, Hrdlicka, Current Work 1900.

IX. Chief Period, Bureau of American Ethnology, 1902-1910; Visits to Stutgart and Chile 1908.

X. Transfer to the Museum June 10, 1910, the Guatemalian Trip, Powell Monuments, Seventieth Birthday Celebration, 1920.

XI. Director of the National Gallery of Art, 1920-1931.

XII. The Freer Gallery of Art

XIII. Portraits, Smithsonian Institution.

XIV. Portraits, Bureau of American Ethnology, National Gallery of Art, and Miscellaneous.

XV. Masterpieces of Aboriginal American Art.

XVI. Various Articles on Art and the Art Gallery.

XVII. Personal.

XVIII. Personal.

XIX. Personal.

XX. Personal. Water Color Sketches.

THE LIBRARY SMITHSONIAN INSTITUTION

THE LIBRARY SMITHSONIAN INSTITUTION